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THE FED MEAL AS AN INDEX OF COLON FUNCTION[1]

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THE majority of gastro-intestinal patients whom we see are referred for study because of functional disturbances. In many instances, it is the colon which presents the most striking departures from normal. These departures may or may not be accompanied by the clinical manifestations of constipation and diarrhea. When there are obvious disturbances of function, our aim should be to explain the underlying cause. When there are no obvious disturbances, the condition of the colon often furnishes information which may be of value to the clinician in his appraisal of the problem.

Despite the great amount of study given to the colon and its mechanism, there is still much that is not known, not only of the nervous control but the factors which tend to disturb the delicate balance of that control. Roentgenologic indications of colon dysfunction are by no means always clear-cut, and the correct valuation of the evidence elicited is often as difficult as it is important.

In my experience, the fed meal affords a far more satisfactory means for the study of colonic function than does the enema. The ideal procedure is the correlation of both methods, but the time required in many instances precludes such a course. Many of the patients referred to our department for study come from a distance, and frequently circumstances compel us to forego the enema. However, I feel that the enema frequently gives a misleading picture. The advancing solution is seen to fill a more or less uniformly constricted distal gut which, as the filling continues, relaxes and finally assumes normal or approximately normal contours as the result of pressure.

I use at times a meal which more nearly simulates the habitual contents of the colon than does the usual contrast meal. For this purpose oatmeal as ordinarily cooked has seemed the most satisfactory vehicle. Other cereals may be used but the oatmeal barium mixture seems to be more palatable than some of the others. This may be taken as part of the ordinary breakfast and observations made in eight and in twenty-four hours and continued as long as indicated. By this means, barium is incorporated with the usual components of cellulose and bulky food material and the behavior of the colon under ordinary conditions is more nearly simulated.

A clear appreciation of the normal colon must be in our minds before intelligent appraisal of disturbed function is possible. Not only must the ideal norm be recognized, but also the acceptable variations in colon morphology and tone. The entire picture de-

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1–5, 1930.

Fig. 1. Normal morphology, slightly hypotonic, as shown by flabbiness of haustral walls.

Fig. 2. Tone is very marked, but is commensurate with bodily habitus of the individual and should be called normal.

pends on progress, tone, haustration, and caliber.

At the end of five hours, the standard meal should have left the stomach and the head of the barium column should be in the ascending colon. Failure to make this progress implies hypomotility, either gastric or of the small intestinal tract, or an obstructive lesion proximal to the ileocecal valve. Neither of these conditions enters into this discussion. In eight hours the transverse portion or even the descending portion to the sigmoid should be filled. From this time on, the classification, normal or abnormal, becomes confused. As a general statement, at the twenty-four-hour observation, the colon should be outlined more or less well throughout its entirety. The cecum and ascending colon may be free from barium or may show dilution of the barium column by the following meal; the pelvic colon and rectum may or may not contain bariumized contents; or the bulk of the meal may be in the distal half of the colon and progress may be called normal. I consider that at forty-eight hours most of the barium should be out of the colon. Certainly the proximal two-thirds should be clear. Here progress and tone must be considered together. If the general picture has conformed to the normal and still does, I do not consider that the retention of a little barium in the pelvic colon or even in the sigmoid is necessarily abnormal, although it approximates dangerously to it.

When appraising the colon, we consider, aside from anatomical variations, caliber, tone, and haustration. Caliber depends on tone. The character of haustration depends on tone also, tone and what may be called co-ordination of the neuromuscular mechanism. The caliber of the normal colon will be approximately uniform throughout its length, gradually diminishing from the cecum to the sigmoid, showing no marked disproportion in any of its segments. Haustral markings will be regular in form, evenly

spaced, and will conform to the bodily habitus of the individual. Figure 1 may be called a normal colon. There is possibly some lowering of tone as shown by the slight flabbiness of the haustral markings, which tend to take their form from their neighbors, but in every other particular it is a classically normal colon.

It must be remembered that the colonic morphology in general conforms to the bodily habitus of the individual. Bodily types run all the way from the hypersthenic to the asthenic and the colon which conforms to the first type would be markedly abnormal if encountered in an individual at the other end of the scale.

In sthenic and hypersthenic persons, haustrations are relatively small and numerous. The caliber of the colon is rather uniformly small and motility is rapid. The asthenic person carries a colon typical of his habitus, long, low, with relatively few coarse haustrations and a correspondingly slower motility.

Between the two extremes of body and colon types lie in the great range of in-betweens, in which the correct estimate is frequently difficult and interpretation will be largely a matter of the personal equation of the observer.

Figure 2 represents a colon which approaches the hypertonic but which so distinctly conforms to bodily habitus that it should be considered normal. But so much tone seen in a hyposthenic or an asthenic person would be markedly disproportionate and should be so designated. Figure 3 shows much the same type of haustration but in an asthenic, undernourished woman. The disparity is obvious.

Departures from the normal picture are recognized by abnormal rate of progress, abnormal tone, and abnormal haustration.

Departures from an accepted normal rate of progress imply disturbance of tone or disturbance of reaction to stimulus, that is, heightened or lowered irritability. Hypermotility due to increased irritability will be evidenced not only by unduly rapid progress of the column in the first hours but by unduly prompt emptying of the cecum or even the whole colon. This often results from irritation arising outside the colon, as from an inflamed appendix. Tuberculous ulceration of the cecum and ileocecal region produces a classical example of hypermotility dependent on increased irritability. Hypermotility may be a result of metabolic disturbances. It is thus a frequent manifestation of an over-active thyroid. It is seen in the presence of achlorhydria. We may not be able from our evidence to designate the cause of the irritability but we can report its presence and it is for the clinician to fit it in with the general picture.

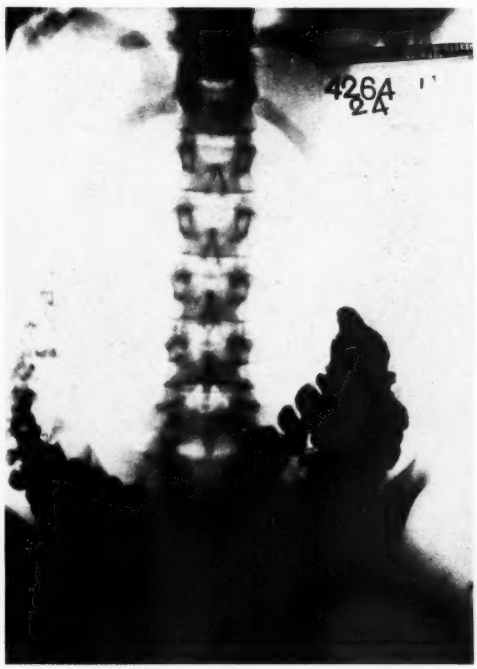

Fig. 3. Tone as indicated by caliber and by number of haustrations would be normal for a sthenic individual, but occurring in an undernourished woman is markedly disproportionate.

Retarded motility may be general or local. It may be in the cecum or proximal colon,

Fig. 4. Very marked hypotonia.

Fig. 5. Moderate hypotonia in a patient with pernicious anemia.

where relaxation and lowered irritability seem to be the causative factors. Considerable emphasis has been placed on this so-called cecal stasis as a symptom-producing entity. It is possible that by the presence or absence of this phenomenon we may call the long or low cecum abnormal or normal. I have seen many slowly emptying ceca which, so far as I could ascertain, were unaccompanied by the symptoms generally ascribed to this condition. Slowing of the progress of the colon contents may at times result reflexly from irritation about the anal ring or in the rectum.

General tone may be increased or it may be diminished. It may affect the entire organ or only a few segments. I am aware that there exist widely divergent conceptions as to the relative frequency with which these two conditions are encountered and their importance in relation to the production of constipation. Doubt is expressed by one writer as to the existence of constipation dependent on or associated with atony. Others contend that so-called spastic constipation is relatively rarely seen. Such widely divergent views, held by recognized leaders, have been to me a cause of considerable confusion and no little groping. It would seem that these contrary teachings are due to the fact that different interpretations are given to similar phenomena by different observers, and, possibly, by the fact that those who question the frequency of the hypertonic or so-called spastic colon have drawn their conclusions from the opaque enema. All of this indicates that there is still much to be desired in our understanding of the abnormal colon. Based on my own conception of the subject, the cases showing increased tone or spasm, general or local, greatly outnumber those characterized by relaxation.

Increased tone is assumed when the cali-

Fig. 6. Haustral deformity interpreted as evidence of avitaminosis.

Fig. 7. Cecocolic stasis: Rigid descending colon, "string sign," with history of frequent discharges of mucus, improperly called "mucous colitis."

ber of the colon is diminished throughout all or part of its length, or when haustral indentations are numerous, deep and, as before emphasized, disproportionate to bodily type. As a result of increased tone there will be an initially increased motility. It is a common occurrence in these cases, however, to find the head of the column at the sigmoid in five hours, this to be followed by a marked forty-eight-hour stasis. When such is the case, I think we are justified in applying the somewhat abused term spastic, or tonic, constipation. In contradistinction to these cases are those which, while exhibiting an initial hypertonia and hypermotility, clear the colon within normal time limits. Increased tone in these cases should be reported, as should the normal emptying.

In some instances, the narrowing which amounts to spasm will be limited to isolated segments. These are the so-called colonic sphincters, and, when narrowing is confined to these segments, suggest the presence of adjacent pathology. Pelvic inflammation at times produces spasm of the sigmoid sphincter, just as appendical pathology frequently produces the same condition of the sphincters of Hirsch and Cannon.

When the general tone is lowered, the caliber is increased and the whole colon has a relaxed, flabby appearance (Fig. 4). Haustral pockets are few and large, tending to take their form from pressure. The colon is lengthened but, in the absence of any standard, the degree of lengthening can be surmised only. Hypotonia is most often an expression of a general disorder. We find it in some cases of hypothyroidism,

in pernicious anemia (Fig. 5), and other conditions characterized by general relaxation (vagotonia).

To be distinguished from alterations in tone are those disturbances of neuromuscular control characterized by irregularity and deformity of haustra. Great variations in size and depth are occasionally seen; or disturbances may be evidenced by serrated edges of the haustra. The whole condition has been likened to a fibrillation as distinguished from normal co-ordinated action. Most often this picture is associated with lessened tone and it should suggest avitaminosis (Fig. 6). It seems to be the local manifestation of the results of a diet deficient in some of the vitamin elements.

It is as great an error to read too much into our films as it is to overlook obvious departures from normal. Our aim should be to interpret correctly and report what is seen without making unwarranted statements or drawing unjustifiable conclusions. So-called spastic constipation is not a necessary corollary of a hypertonic bowel. There may be hypertonia and there may be constipation but the constipation may be dependent on any one of several other factors.

Colitis is a word which, it seems to me, is much too freely used. For want of a better one, too often it becomes a handy peg on which to hang a diagnosis when the urge to say something definite is too strong to be resisted.

The suffix "itis" means inflammation. Its use should be reserved for those cases, bacillary or protozoan in origin, in which it really occurs. But these cases come under the category of organic pathology, rather than functional disturbance. So-called mucous colitis is not an inflammatory disease of the colon; it is a local manifestation of profound disturbance of nervous and nutritional balance, which often has an hereditary background (Fig. 7).

In most instances the functional disorders of the colon are not *per se* the causes of the symptoms from which the patient seeks relief. They are one and only one element of the general picture. The colon functions normally because of the harmonious operation of a delicate mechanism of nervous impulse and muscle response. This balance is rather easily disturbed and dysfunction, either temporary or long continued, results, but dysfunction is the result, not the cause.

DISCUSSION

DR. JOHN D. CAMP (Rochester, Minn.): I think I can add very little to Dr. Smith's very excellent summary of the facts of colon function. Too many times the roentgenologist is crowded into making a diagnosis of dysfunction of the colon by an energetic gastro-enterologist. The great majority of us have endeavored to concentrate our attention on the detection of pathologic conditions, probably rightfully so, and it is only when our colleagues who devote most of their time to gastro-enterology attempt to find a functional basis to explain many of the symptoms that we are apt to get interested in the so-called functional side of gastro-enterology and to attempt to analyze some of these symptoms and changes in our film.

I think that a barium enema is a very excellent medium with which to elicit pathologic conditions, but it is a most unphysiologic agent with which to endeavor to study colon function. I think the majority of all our functional studies have been carried out with barium. We all know that this agent, when it gets in the colon, causes dehydration, and I doubt if the findings we see, which we now call normal, would hold water if we could find an agent which approaches the normal condition. There have been reported several different agents of a colloidal nature which have been used, especially in Germany. I think that, if we use some of these colloidal agents which are not associated with dehydration, we will probably have to revise somewhat our ideas of what the normal colon is.

I think Dr. Smith is perfectly right—we should be extremely cautious in what we call abnormal motility and the like, and not be influenced too greatly by pressure which may be brought to bear on us by some of our enthusiastic colleagues.

X-RAYS MAY IMPROVE USEFUL PLANTS

A new tool of importance in the control of agricultural production of the future may be in the use of X-rays or similar short wave vibrations, Dr. W. W. Garner, plant physiologist of the United States Department of Agriculture, believes. Experimentation in this field is so new that some of the most striking effects have not been followed far enough to reveal their ultimate results. Wild corn plants appear to have been changed from annuals to perennials at Cornell University by treating the seeds with X-rays. And in accordance with experiments in various other places, the evidence seems to be that under suitable conditions X-rays do bring about a mutation.

The scientist may, therefore, be able to take some sort of hand in plant evolution. The importance this could have on crop production cannot be overestimated, Dr. Garner said. However, the future will show to what extent this new tool can be effectively applied in crop improvement.

Work along these lines upon plants is being done at the Universities of Missouri and California, while at the University of Texas the effect of X-rays on the progeny of certain flies has been studied.

CONGENITAL CYSTIC DISEASE OF THE LUNG[1]

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CONGENITAL cystic disease of the lung is encountered frequently enough to merit the attention of clinicians and radiologists. It may not be amiss to bring its various manifestations to your notice, for not infrequently its diagnosis will be a purely radiological one. I shall endeavor, therefore, to sketch the anatomy and clinical pictures of this disease, to explain as far as I am able its radiological characteristics, and to discuss six fairly certain and several doubtful cases that have come under my observation. You may judge of its frequency by the fact that, while I was able to present four cases to the Pacific Coast Surgical Association in February of this year [1930], I have in the intervening nine months seen certainly two others, perhaps more.

The lung develops as a bud sprouting from the primitive esophageal tube. Complexity of adjoining structures simultaneously undergoing changes in size, shape, and position render the lung peculiarly prone to developmental variations and anomalies, the number of its lobes and their position and relation to the great vessels being subject to frequent variation. The growth and obliteration of Cuvier's duct, a duct connecting the cardinal veins with the heart, influence particularly the left lower lobe. Sauerbruch and his assistant, Lotzin (1), have thought that pressure from this duct has much to do with the formation of bronchiectases, many of which they think are congenital. They explain the predilection of bronchiectasis for the left lower pulmonary lobe on these grounds. By careful studies they have found abnormal displaced fetal remnants scattered through the parenchyma of many bronchiectatic lobes.

Accordingly as the various deforming structures act upon the fetal lung early or late, and more or less extensively, so greater or lesser areas of lung are affected. Thus small particles of lung tissue may become partially or totally detached from the rest of the organ; solitary cysts may occur in the body of the lung itself, or adjoining it in the structures of the mediastinum, or quite separately. Accessory rudiments have been described as lying even in the abdominal cavity, quite cut off from the rest of the lung by closure of the diaphragm. If the cysts retain an open bronchial connection, they will contain air; if the bronchi leading to them are closed or end blindly, they contain fluid. The cysts may be solitary or multiple; an entire lobe, or both lower lobes, or even an entire lung may be the object of cystic degeneration. The cysts may be minute; they may be very large, so that a lobe will resemble a bunch of large grapes, or a whole lobe may be converted into a single thin-walled cyst. Clinically they may be separated into two forms: the infantile, with alarmingly acute attacks of dyspnea, and the more chronic form which comes to notice mainly by reason of superimposed infections.

The infantile form has been described in this country by Miller (2). Infants are subject to most alarmingly acute attacks of dyspnea, which are often mistaken for an acute spontaneous valve pneumothorax. They are cyanotic and intensely dyspneic; their dyspnea increases as they cry and struggle. The affected side is blown up with air, and the heart and mediastinum are pushed far over to the sound side, compressing the sound lung. A needle inserted into

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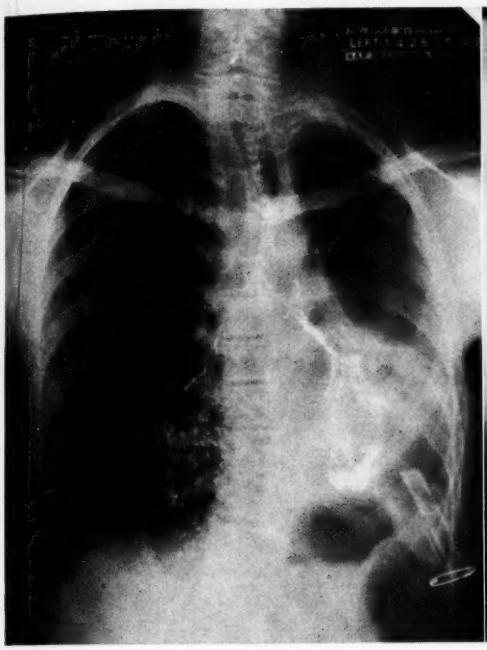

Fig. 1. Case 1. Lipiodol injection. Multilocular cystic degeneration of left lower lobe and large unilocular cyst of left upper.

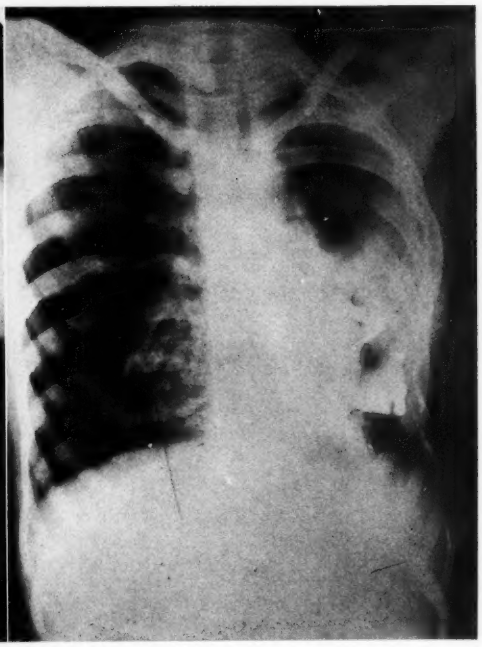

Fig. 2. Case 1. Lipiodol injection after operation.

the chest releases air under pressure which escapes with a puff, as in pneumothorax. The air, however, is not entrapped in the pleural cavity, but in the lung itself. The main bronchus is the seat of a valvular stenosis which allows more air to enter on inspiration than can escape on expiration, so that with each succeeding breath more air is entrapped in the lung. The suddenness of these attacks and the physical signs—hyperresonance, absent breath sounds, with distention of the affected side, lateral displacement of the mediastinum and downward displacement of the diaphragm, as well as the increased intrathoracic pressure—have led to a mistaken diagnosis of spontaneous pneumothorax. The roentgenogram, however, reveals a straight shadow, corresponding to the interlobar fissure, running across the translucent chest, a shadow which permits of differentiation between acute distention of the lung itself and pneumothorax, *i.e.*, distention of the pleural cavity with air, but collapse of the lung. This shadow, to which Clairmont (3) has called attention, is seen in the figure accompanying Miller's paper. It has not been

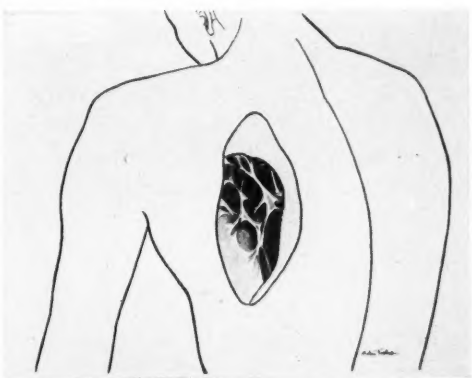

Fig. 3. Case 1. Multilocular cysts of left lower lobe opened. Drawn after photograph by Dr. H. E. Ruggles.

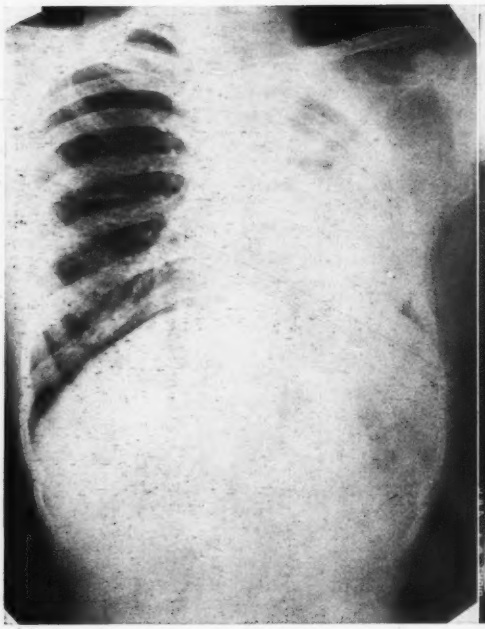

Fig. 4. Case 2. Congenital cystic lung before lipiodol injection; uniform grayness and retraction of left chest. Heart and trachea displaced to left; left diaphragm high.

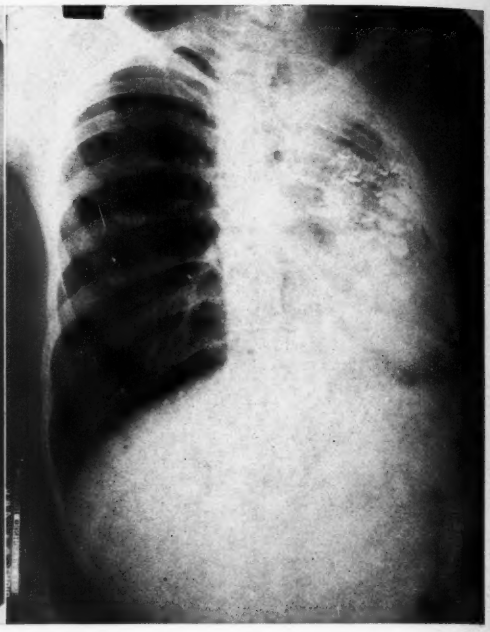

Fig. 5. Case 2. Same, after lipiodol injection. Large puddles of lipiodol throughout left lower lobe.

my privilege to observe the infantile form of cystic disease. Pediatricians and roentgenologists should see it more frequently than surgeons. The alarming dyspnea may be relieved very simply by letting the compressed air out of the lung with a needle or with a valve drain.

The chronic form of cystic disease is not rare. In my first patient, for a time I failed to recognize wherewith I had to deal, mistaking the cystic left lung for a communicating empyema. However, I may console myself with the fact that Sauerbruch fell into exactly the same error with his first two patients.

Case 1. The first patient, whom I owe to the kindness of Dr. James W. Ward, was a young student of twenty. There was no lung trouble in the family. The boy had had all the ordinary diseases of childhood—measles, whooping-cough, scarlet fever, and frequent sore throats. Before his present illness he had had his tonsils removed; since then he had had no further trouble with his throat. As a child, he had a lymphadenitis and lymphangitis of the arm following an injury which confined him to bed for several weeks. He recovered from all of these infectious ailments with no difficulty; none of them affected his chest.

At the age of nine years he had what was thought to be a pneumonia that lasted six weeks; with it he had a constant cough, but no expectoration. The pneumonia was thought to have been followed by an empyema. Since that illness, he had had an attack of fever about every six months. His chest was aspirated periodically and finally was opened by Dr. Ward in 1920, much pus being evacuated. The chest has remained open ever since and the patient wears a drainage tube in it. Bismuth paste was in-

jected into the opening a number of years ago; he promptly coughed out the paste.

I first saw him for a short visit on September 12, 1927. He was a lad about 6 feet, 2 inches in height, weighing about 110 pounds. The pulse was 60; the blood pressure 120/80; there was no rise in temperature. Although he was very thin, and dyspneic on exertion, he felt fairly well except for his chest.

The cervical and axillary glands were moderately enlarged and soft. The skin was of the pale, greenish hue of chronic sepsis. The thyroid was about one and one-half times the normal size, soft, and of uniform consistency.

The chest was flat; the left side was retracted and stood still. It was tympanitic upon percussion. There were no breath sounds to be heard over it. There was a drainage tube inserted into a small opening in the tenth rib, at the line of the scapular angle, but there was very little secretion from the tube. Air escaped from the drainage opening when the patient breathed or coughed and a few drops of ether injected into it immediately provoked a cough. The right side of the chest was free; there were no râles at either apex.

The heart was displaced one inch to the left of the left nipple line; the right border lay one-half inch to the left of the sternum.

The liver and spleen were not enlarged and not palpable; the rest of the abdomen was normal.

There was no edema.

The urine was normal. The blood count was as follows: Hemoglobin, 85 per cent (Sahli); red blood cells, 5,880,000; white blood cells, 7,800; polymorphonuclears, 68; lymphocytes, 32.

Dr. John Rehfisch reported the X-ray examination as follows:

Chest (Oct. 11, 1927).—Fluoroscopically the left diaphragm cannot be distinctly made out though its dome is more or less well outlined by a gastric air-bubble below. It does not move. The right diaphragm is hyperactive.

Fig. 6. Case 2. Same; lateral projection.

Stereoscopic antero-posterior chest films show a very marked collapse of the left lung with a large pneumothorax occupying practically the entire upper half of the left chest. The lower lobe would seem to be not so well collapsed. It is densely atelectatic and the bronchial tree supplying it, which is air-containing, can be well made out below the heart shadow. This is especially well demonstrated when the plates are viewed stereoscopically. A portion of the tenth rib has been removed posteriorly and a drainage tube is inserted through this bony defect into the lower portion of the left chest just above the diaphragm. There is no fluid present. The heart and mediastinal contents have been displaced toward the left and much of the hilum shadow of the right lung lies behind the vertebral column. The right lung itself appears normal as far as active pathology is concerned. There is a small calcified nodule at the right top.

Conclusion.—Drainage tube in left chest,

Fig. 7. Case 3. Left-sided cystic degeneration. The lung contains many cavities; the left chest is contracted, the mediastinum drawn to the left.

with complete collapse of upper lobe and partial collapse of lower left lobe.

Lipiodol injection of chest (Oct. 12, 1927).—Fluoroscopically the lipiodol is seen to be partially obstructed just below the point where the left major bronchus takes origin. A considerable amount of oil drips slowly down past this point and enters a small biloc-ular puddle with its lower margin at the summit of the dome of the diaphragm. This puddle has a clearly demonstrable connection with two large bronchi and its bronchial relations are beautifully demonstrated in the stereoscopic films.

The lateral view shows that this bronchiectatic puddle is very near the dorsal border of the left base. When the patient raises his intrathoracic pressure voluntarily, the oil is forced upward and out of the drainage tube.

Conclusion.—Stenosis of the left lower bronchus with peripheral bronchiectatic dilatation in the partially collapsed lower left lobe with a bronchial fistula connecting it to the outside world.

I diagnosed a chronic empyema with a bronchial fistula, and thought it most likely that we had to deal with a congenital bronchiectasis that had perforated into the chest. I advised an attempt at closure after the manner of Keller (4).

I may as well state here that both Dr. Rehfisch and I were mistaken. What we took to be a large pneumothorax cavity was not a pneumothorax, but a huge unilocular cyst of the left upper lobe. The left lower lobe was not collapsed, but consisted of a series of bronchiectatic cysts, and the drainage tube lay in one of these cysts and not in the pleural cavity.

On October 20, 1927, under satisfactory gas and local anesthesia, a curved incision was made over the left chest and about five or six inches of three ribs were resected. Upon opening the pleura, one entered a sacculated multilocular cavity into the top of which an open bronchial mouth debouched. The upper part of the chest, which from the radiographs seemed to consist of one large pneumothorax cavity, was now seen to be closed from the present thoracic opening by the above-mentioned membrane. The pericardium lay at the front of the wound. The soft parts were brought down over the pericardium with one mattress stitch, and the rest of the wound was left open, the sacculated cavity being packed with balsam of Peru gauze. It appeared probable that the cavities were bronchiectatic.

The boy made a good recovery.

On November 7, 1927, my notes read: "The old cavity, exposed at previous operation, is clean and granulating. The pericardium is visible in the bottom of it, and between it and the chest wall lies a trabeculated meshwork into the pouches of which various bronchi debouch. Touching these bronchi immediately provokes a cough.

The upper part of the pleural cavity which radiographically seems to consist of a single large space is not opened by this first operation; a needle introduced into the upper chest in two places withdraws air. In order to open the upper part of the chest, therefore, two and one-half inches of two more ribs are resected from about the costal angle forward. The underlying parietal pleura is about one-eighth inch thick; underlying it and clearly separable from it in a cleavage plane is another thin membrane, perhaps one-thirty-second inch thick; when this is entered one looks into a large, gray, glistening cavity, occupying the whole upper chest, its medial surface pierced by numerous openings, the largest perhaps one-eighth inch across, some of them running as tunnels superficially in and out of the thin membrane, others probably running toward the bronchi. Between this very large cavity and the multiple trabecular ones, opened at the previous operation, lies a thin, but tough, fibrous septum perhaps a little over one-fourth inch thick, which in its center clearly carries a little spongy lung tissue. This septum runs on to the chest wall and completely separates the newly opened, very large upper cavity from the small trabecular ones opened at the first operation.

"*Diagnosis.*—Congenital maldevelopment, left lung. Bronchiectasis of lower left lobe, and enormous bronchiectasis of left upper."

After about a week the drainage tube was removed from the large cyst of the upper lobe. The opening closed and no further fluid collected in it. The trabeculæ of the lower lobe shrank in the course of the patient's two months' stay in hospital, leaving exposed the large, shallow, half opened pouches that represented the open cysts of the left lower lobe. They were lined with a velvety, red, bronchial mucosa. Touching them provoked no cough, but the large lumina leading toward the hilum were extremely sensitive, so that touching them with an instrument sent the patient into fits of coughing. The pouches secreted a clear, thick, viscid mucus.

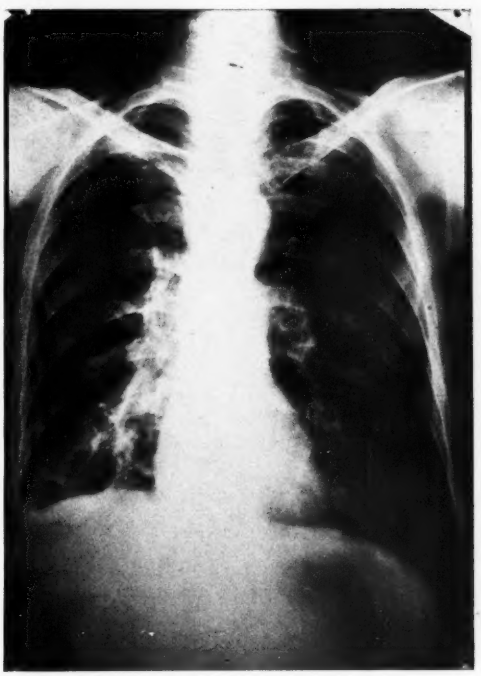

Fig. 8. Case 4. Polycystic degeneration of right lower lobe, which is made up of a collection of large whorl-like annular shadows.

On January 24, 1928, the sacculated and open lower lobe was dissected off from the pericardium and diaphragm to which it was attached, partly with a knife, partly with the galvanocautery. A thin layer of alveolar parenchyma surrounded the large pouches. At the end of the dissection two large bronchial branches led into the left lower main bronchus. These were cut across, the vessels of the hilum were tied, and the bronchial mouths closed with fine black silk sutures. The soft parts, the skin, and the subcutis were loosened, dropped in over the bronchial stump, and loosely united with silkworm gut sutures. A transfusion was done on February 7.

The boy again made a good recovery and

Fig. 9. Case 4. Same; lateral projection.

Fig. 10. Case 4. Same, after lipiodol, a little of which fills the bottom of the cysts at the right base.

on March 12 was sent home with a small sinus leading to the stump of the left lower main bronchus which still secreted a few cubic centimeters of mucopus daily. Since he has been at home, a few black silk sutures have been discharged from the sinus. A lipiodol injection shows it to lead into the left main bronchus. No connection between the large cyst of the left upper lobe and the sinus is demonstrable.

The boy has been at school for two and a half years. A minute bronchial fistula, discharging a few drops daily, still persists. The upper cavity has given no trouble and remains empty. The lad, although free of fever and sepsis, is still much underweight.

We have to deal with a large unilocular cyst of the left upper lobe and multiple cystic bronchiectases of the left lower lobe.

Two other patients had equally extensive lesions, but with smaller cysts.

Case 2. M. P., an Italian boxmaker, twenty years of age, entered the Tuberculosis Department of the San Francisco Hospital in Dr. W. R. P. Clark's service on April 15, 1929. He complained of a dry cough of one week's duration which troubled him most at night. Four days before entry he had spat up perhaps a tablespoonful of bright blood. Except for this recent complaint, he had considered himself well and healthy.

He was a thin young man in no distress. The chest was thin, poorly clothed; its movements were restricted on the left side. The heart was markedly displaced to the left. The apex of the left lung was dull and the fremitus was increased here, but diminished at the left base. Over the whole left side

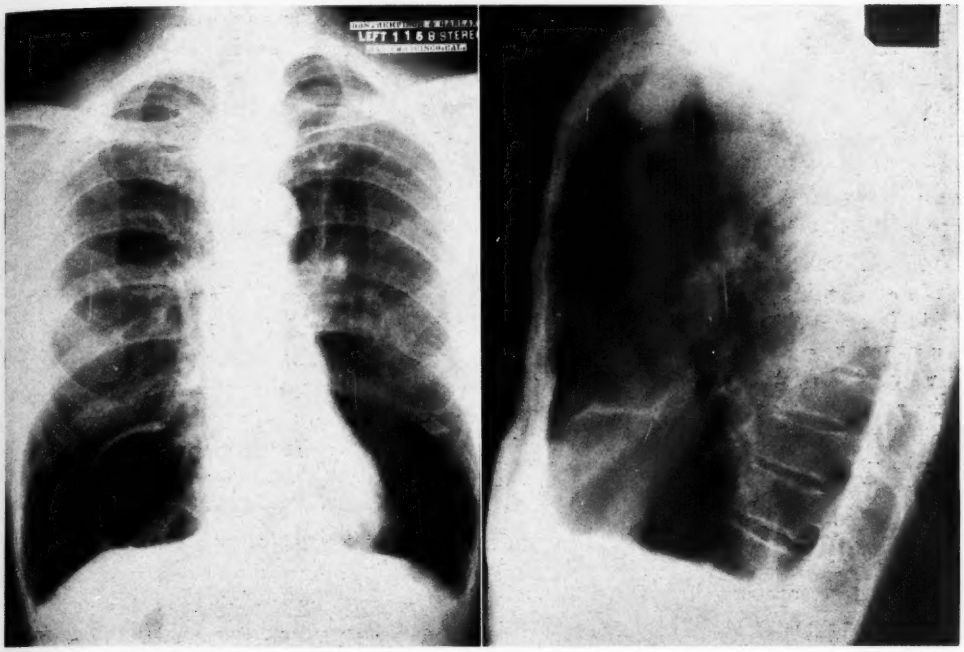

Fig. 11. Case 5. A large, thin-walled unilocular cyst at the medial side of the right base; suggestions of similar cysts at the lateral part of the middle of the left lung field.

Fig. 12. Case 5. Same; lateral view.

the breath sounds were diminished, and there were many râles. The right side was free. Bronchoscopy by Dr. R. S. Tillotson (5) revealed a narrowing of the left main bronchus beyond which the instrument could not be passed. The carina, instead of occupying the normal anteroposterior position (vertical in appearance, as viewed through the bronchoscope with patient lying on his back), occupied an oblique position. The relative diameter of the upper or left main bronchial orifice was much smaller than that of the right and presented in its upper portion a slightly granular appearance, not reddening or bleeding on touch, as would suggest true granulation tissue. The orifice of the left main bronchus was too small to admit the tip of the 7-mm. bronchoscope. No free secretion was noted coming from this orifice. On passing the bronchoscope along the right main bronchus, a small, apparently anomalous, bronchial orifice was noted in its left lateral wall less than 1 cm. from the carina. On subsequent lipiodol injection, this appeared from the X-ray film to communicate with the left main bronchus. The upper lobe bronchial orifice on the right and the orifices of the middle and lower lobe bronchi on the right were identified and appeared normal. No free secretion was encountered in the right main bronchus. No granulations or ulcerations of the mucosa were noted. A No. 12 rubber catheter was introduced through the bronchoscope to the left main bronchus after which the bronchoscope was withdrawn and the catheter left *in situ*. The patient was moved to the fluoroscopic room and lipiodol

was introduced through the catheter with a Luer syringe, the distribution of the oil being observed under the fluoroscope. X-ray plates, taken immediately following in the anteroposterior and lateral planes, were reported by Dr. Rehfisch as follows:

There is a very satisfactory lipiodol injection of the posterior portion of the collapsed left lung. The lipiodol is gathered in small puddle-like masses, demonstrating the presence of a grape-like cluster of bronchial dilatations. In view of the total absence of clinical evidence pointing toward true bronchiectasis, the possibility of a cystic dilatation of the bronchi must be strongly considered.

On June 8, 1929, bronchoscopy was repeated. The appearance of the tracheobronchial tree, open to inspection through the bronchoscope, was the same as at the examination of May 21, 1929, except that, in this examination, the granular contour of the upper portion of the left main bronchial orifice was not noted.

The patient was free of fever while in the hospital. No tubercle bacilli were found in the sputum. The Wassermann reaction was negative.

Case 3. Dr. Cullimore, of Spanish Fork, Utah, kindly brought the third case to me while I was on a visit to Salt Lake. The patient was a farmer's wife, aged 28, in the fifth month of her fifth pregnancy.

About five years previously, she had begun to cough and has coughed ever since then. Two of her four children were born before she began to cough and two afterwards. She was aware of no intermittent attacks of fever. She was somewhat dyspneic at times, but was able to carry through two pregnancies without too much difficulty. The sputum never contained blood and was never foul. No tubercle bacilli were found in some six specimens. To judge from her cough I should have said she spat up 500 c.c. or more a day. She felt tired and would have gone to bed had her children and her work on the farm permitted. Two years ago she weighed 87 pounds; she now weighs 100 pounds.

She was under par mentally and was inclined to belittle her symptoms. On examination I found a thin, overworked little woman with protruding teeth. Her nasal breathing was free. The tonsils were moderately enlarged. There were no glandular enlargements. The fingers were not clubbed. The right chest was contracted and lagged. The breath sounds at the apex were amphoric and loud; lower down they were tubular; at the base they were diminished. Posteriorly the right chest was dull but not flat. The heart was displaced to the right. The bronchoscope revealed a small larynx with a strongly curved epiglottis. The bronchoscope entered easily and brought to view a normal trachea. The carina was rotated, its anterior edge looking to the right; the right bronchial tree was very red and contained much pus. The left side was normal.

Dr. Rehfisch reported on the X-ray examination as follows:

Anteroposterior films of the chest in this case show a marked collapse of the right lung with an extraordinary retraction of the heart and mediastinum to the right, the apex of the heart itself lying to the right of the vertebral margin. The lower two-thirds of the right chest is densely opaque as may easily be accounted for by the presence of the displaced heart and the inevitably collapsed lung, but the upper portion of the right lung field is scattered with small, irregularly oval, translucent areas suggesting honeycombed foci of cavitation or cyst formation. The left lung is essentially clear.

Disregarding the known clinical evidence, the deductions permissible from the X-ray examination would seem to be limited more or less to two possibilities, namely, advanced unilateral phthisis with extreme fibrous retraction and multiple cavitation of the upper

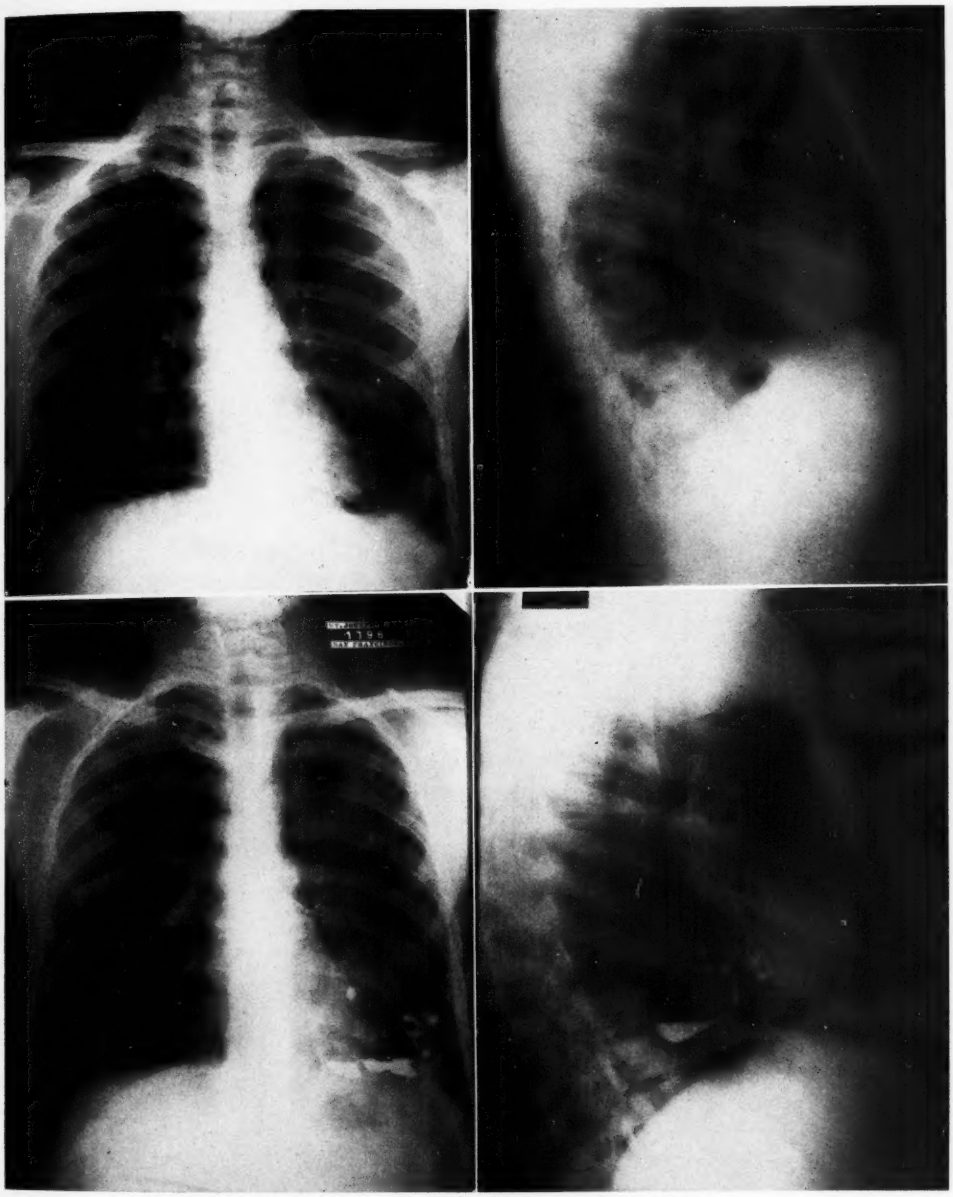

Fig. 13 *(upper left)*. Case 6. A large cyst and several smaller ones at the base of the left lung.
Fig. 14 *(upper right)*. Case 6. Same; lateral projection.
Fig. 15 *(lower left)*. Case 6. Antero-posterior view after lipiodol injection. The oil puddles in the cysts at the left base.
Fig. 16 *(lower right)*. Case 6. Same; lateral projection.

lobe, or to longstanding and complete bronchial obstruction of the right major bronchus with collapse of the lung and secondary infection and abscess formation.

With the knowledge, however, that the lesion has been present five years, during four pregnancies, with repeated failures to demonstrate tubercle bacilli, and with definite

bronchoscopic evidence that the bronchus is clear of obstruction, the case becomes very puzzling indeed, and a definite X-ray diagnosis is, to my mind, impossible.

Dr. Howard E. Ruggles considered the case one of fetal bronchiectasis. I advised that the end of pregnancy be awaited, that after this the tubes be tied, and that finally a thoracoplasty be done.

The fourth patient had a widespread basal malformation.

Case 4. S. J., an American teamster of 43 years, who had been heavily addicted to morphin for years, entered the San Francisco Tuberculosis Hospital in January, 1930, for the fourth time—his first entry had been in 1927. I saw him on November 17, 1930. He stated that he had been subject to colds as a child. Until 1920, he had been able to work as a farm hand, with occasional interruptions on account of fever.

He had coughed and expectorated quantities of purulent, malodorous sputum for 25 years. He had his first hemorrhage 15 years ago and has bled occasionally since. He had influenza in 1918; otherwise he has been free of infectious disease.

He was very thin. The fingers were clubbed. The trachea lay in the midline. The right chest lagged, especially at its base, but the heart was not much displaced, nor were the intercostal spaces much contracted. The right base was dull and full of coarse, bubbling râles. The apex and the left side were free. The temperature was usually normal, but there were occasional elevations to 103°. Frequent sputum examinations revealed no tubercle bacilli. X-ray examination of the chest revealed a collection of annular shadows at the right base.

Bronchoscopy was done on November 18. The carina was normal, except that the left lateral bronchial wall bulged a little, making the lumen the shape of a grape seed in cross-section. The left bronchi were normal. The 8-mm. tube passed easily into the right bronchus and was introduced to a level of 43 cm., traversing countless sharp septa lying between trabeculations. At this level the bronchoscope lay in a cavity which had a pale membrane and was too large to permit of sufficiently detailed exploration. Lipiodol was injected. The patient coughed it out into the left side; however, a little of it remained and puddled in the cysts at the right base.

Diagnosis: Cystic right lung. No evident deformity of the bronchial tree.

These four patients present examples of multiple cyst formation. Two others were carriers of more localized cystic degeneration.

Case 5. P. S., a retired saloon keeper of 60 years, who had had occasional attacks of cough and fever, thought by him to be "grippe," consulted Dr. Arthur Sonnenberg for bleeding from the rectum. The patient had paid no attention to his cough and had not had sufficient trouble with his chest to cause him to consult a doctor. On examining the chest as usual before beginning the gastro-intestinal roentgenography for which the patient was sent to him, Dr. Rehfisch was struck by an annular shadow at the bottom of the right chest and took films, reporting as follows:

Fluoroscopically the diaphragm moves well and equally on both sides. The posterior mediastinum is clear. There is a delicate linear shadow near the right base which marks off anteriorly a segment of lung which suggests a possible cystic middle lobe. This may on the contrary, however, be only a markedly fibrous interlobar septum. There is also a possible congenital cyst at the base of the left lower lobe. The upper two-thirds of the lung fields are clear and the heart and aorta are within normal limits of size and shape.

The bleeding, due to rectal polyps, was relieved by Dr. Sonnenberg's treatment. Knowing of my interest, he kindly allowed

me to examine his patient. The right chest of this pale, not very well preserved man of 60, was distinctly although not greatly retracted and moved less than the left. There were basal crepitations on both sides, but no changes in breath sounds and no differences in resonance. The apices were perfectly free.

On May 8, lipiodol was injected. Dr. Rehfisch reported:

Approximately 20 c.c. of lipiodol were injected into the right base. The injected bronchi are very interesting in that they almost completely surround the thin-walled cystic sac in the right lower lobe. Their relation to this cyst is beautifully brought out in the stereoscopic views. The small peripheral cyst at the costal diaphragmatic angle is also clearly made out, though unfortunately here, too, no oil entered the pathological focus.

Bronchoscopy was not done, nor was the patient treated for his cyst, as there were no symptoms to warrant it.

Case 6. F. B., a robust young man of 23 years, was referred by Dr. S. with a request for an opinion. The young man had asked for Dr. S.'s daughter in marriage, but Dr. S., upon inquiry, found that Mr. B. had a cough. B. considered himself perfectly well and fit, had worked hard as a rancher, and had spent some time at Stanford University, where he trained on the football squad. He related that at the age of 12, while putting his shoulder to the wheel of a mired wagon, he suddenly began to cough, and after this was laid up for three weeks with cough and the expectoration of sputum. He does not remember whether or not he had fever. He knows of no reason for his illness. There is no history of aspiration of a foreign body, of pneumonia, or other assignable cause. He was brought to Oakland under the care of Dr. von Adelung, who tapped the chest at various points, and, on finding pus, drained it. The tube was removed after a few weeks, and the boy returned to his ranch.

The cough stopped, but returned some three years later. Since then he has coughed more or less and can always produce sputum, as he says, by standing on his head. For a time he could not lie on the right side, but he is now able to do so.

The patient is a robust, healthy looking boy of 23, whose forehead projects unusually far above the nose. The tonsils were not inflamed and the teeth were good. The cervical lymph nodes were about the size of beans. The axillary glands were not enlarged.

The left shoulder was higher than the right, but the respiratory movements of both sides were almost, if not entirely, equal. There was the scar of the above-named drainage operation in the left lower chest, between the posterior and anterior axillary lines, with coarse râles here.

When he was put on the table and made to lean forward with his head over the edge and his body down, the patient immediately expectorated nearly half an ounce of foul, almost entirely purulent sputum which contained some small inspissated chunks. The chest was otherwise negative; in particular, the apices were free.

The abdominal organs gave no evidence of abnormality.

Conclusions.—I advised that films be taken of the chest and sinuses. I considered it likely that this boy was still harboring the remains of an empyema on his left side.

X-ray Report.—The heart vessel shadow is normal in size and position. The hilar markings are heavy and the pulmonary tree markings radiating into the left lower lobe appear as curious, whorled streaks. These are strongly suggestive of large, thick-walled cysts or cavitations. In a lateral view a somewhat dense horizontal line is noted at the left base posteriorly.

Examination of the sinuses shows a very light degree of grayness in both maxillaries and frontals (the latter being rudimentary). This is indicative of slight, chronic mucous

Fig. 17. Case 7. Early film with fan-shaped density (abscess) of right upper lobe.

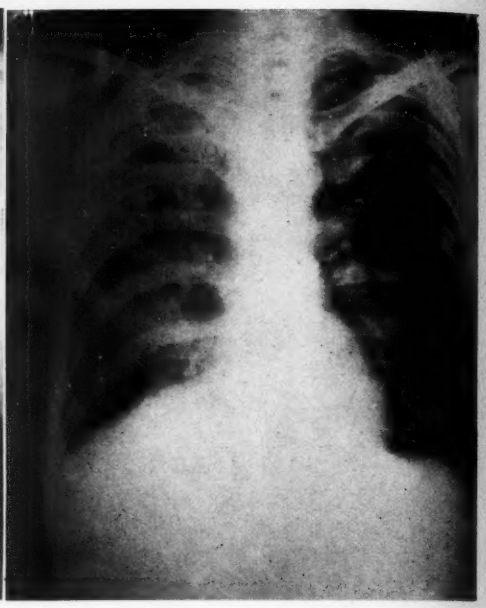

Fig. 18. Case 7. Later film, showing acquired diffuse bronchiectatic dilatation.

membrane thickening. The anterior ethmoidal cells appear a little gray.

Conclusions.—Peculiar, cyst-like cavitation throughout the left lower lobe, without evidence of pneumonitis or infiltration. Probably chronic, basal, pleural thickening, with possibly a little fluid.

Chest after injection of lipiodol (Oct. 26, 1929).—The main bronchi entering the left lower lobe appear normal, and two large cavities are seen, with a little lipiodol in their inferior portions. Five small sacculi are also seen.

After consultation, it seems strongly probable that there is a congenital, cystic condition of the left lower lobe, there being at least three large cyst-like areas and several small ones. The sputum contained masses of pus cells and varied organisms, with morphology and staining characteristics of *Bacillus Pfeifferi* and *Micrococcus catarrhalis,* as well as a few chains of streptococci, but no tubercle bacilli.

I considered operation not warranted in view of the mildness of symptoms.

Infection and suppuration in these large cystic cavities bring them to the patient's notice. As long as they are uninfected, the smaller cavities at least remain symptomless, although occasionally very extensive involvement will produce dyspnea. Thus the retired saloon keeper never knew that anything was wrong with his lung, his cyst being discovered quite accidentally during the course of a gastro-intestinal examination by the X-ray.

The symptoms are twofold: in the infantile form they are due to inflation of the cyst with air entrapped behind a stenotic opening. The inflated lung pushes over the delicate infantile mediastinum and compresses its unaffected neighbor, reduces still further the abnormally small breathing surface, and causes attacks of severe dyspnea. Crying and struggling increase intrathoracic pressure and therewith also the dyspnea.

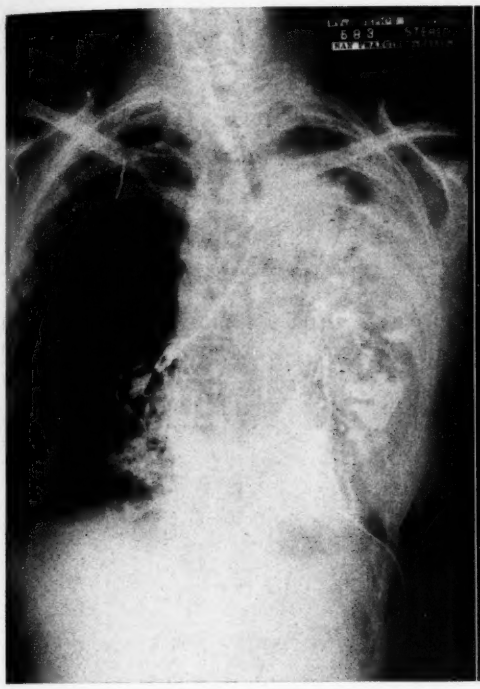

Fig. 19. Case 8. Huge bronchiectases of left lower lobe after drainage operation; lipiodol introduced into wound. Cause of disease uncertain, possibly congenital.

Fig. 20. Case 8. Same; large cavities of left upper lobe filled with lipiodol introduced by mouth.

The adult cystic lung may remain symptomless as long as the cysts are aseptic. The mediastinum and the rib cage are rigid enough to withstand inflation. The symptoms are those of infection in the bronchial tree and its end-branches: expectoration and cough when the bronchi are open and the cysts can be well emptied; fever, sepsis, chronic pneumonia, and pleurisy, interspersed by acute exacerbations when the infected cysts are partially or completely closed.

Clinical signs of infantile cystic disease resemble those of pneumothorax. The chest is inflated, especially the affected side; the diaphragm is drawn down, the mediastinum pushed over. The affected side stands still or moves but little in breathing; it is hyperresonant, its breath sounds are diminished or absent. In the acute attack, the child is blue, dyspneic, and struggles for breath.

In the adult form, signs vary with the extent and situation of the cysts and with the stage and character of the infection they may harbor.

Solitary cysts lying within the parenchyma of the lung are usually impossible of clinical demonstration. If they lie at or near the hilum, they may by outside pressure compress a major bronchus or one of its branches and cause signs of bronchial stenosis. Such cysts have been described by Rach (6), Gibson (7), and others. Polycystic disease affecting one or more whole lobes, usually one or both of the lower ones, will give signs of bronchiectasis: diminished respiratory excursion and possibly localized contraction of the lower part of the chest.

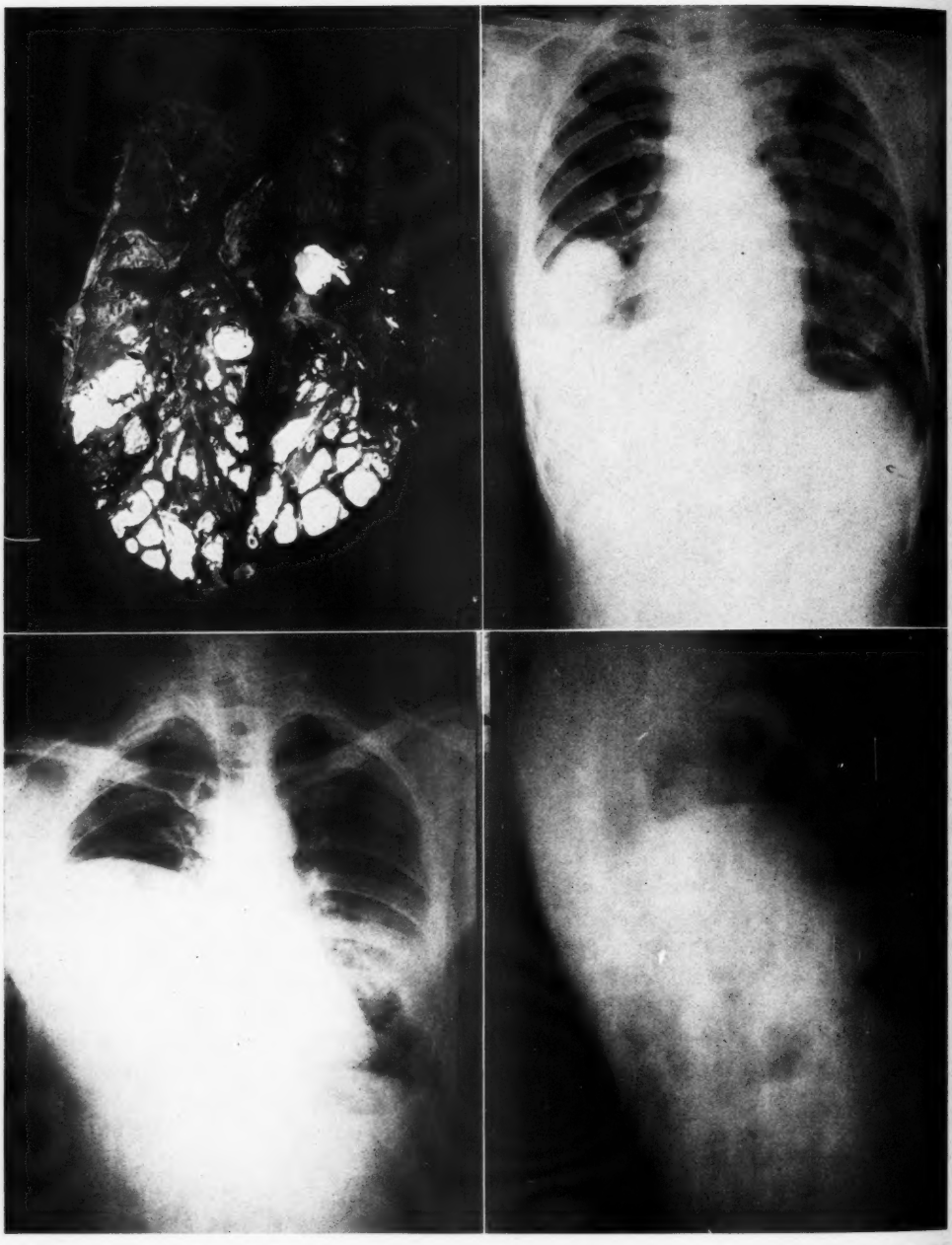

Fig. 21 *(upper left)*. Section through base of bronchiectatic lung with huge cavities at both bases, probably but not certainly congenital. The cavities were injected postmortem with a barium sulphate gelatin mixture.

Fig. 22 *(upper right)*. An encapsulated tuberculous abscess resembling a cyst; other tuberculous foci at both apices.

Fig. 23 *(lower left)*. A large encapsulated tuberculous pleurisy of five years' duration resembling a cyst. Grayness of middle of left lung field due to an interlobar fluid collection.

Fig. 24 *(lower right)*. Same; lateral projection.

The affected area is more often dull than hyperresonant, for the cysts are more often full of secretion than of air; often, too, they are covered by a thickened pleura. The breath sounds may be diminished or they may be loud and tubular, according as the bronchi are more or less open; catarrhal and parenchymatous inflammatory processes document themselves by pleuritic creaks, coarse bubbling râles, and coarse crepitations.

Polycystic degeneration of a whole lung gives rise to the most extravagant thoracic deformities. The affected side of the chest is greatly shrunken; the trachea, mediastinum, and diaphragm are drawn over into it, the intercostal spaces narrowed; the ribs touch each other and overlap in horizontal instead of vertical planes. The affected side is dull or flat, breath sounds are diminished or absent, occasionally tubular and loud, and are accompanied by manifold creaks, squeaks, and râles.

Suspicion of infantile cystic disease will be awakened by the typical alarming dyspneic attacks in an infant presenting signs of unilateral increased intrathoracic air pressure. Differentiation against a spontaneous pressure pneumothorax will be possible by means of the X-ray, which will show in the hyperlucent lung field a shadow corresponding to an interlobar septum.

A history of long-continued cough and expectoration dating from childhood, with signs of chronic bronchial suppuration, but without demonstrable etiology, will arouse suspicion in the adult. To suspect the disease is easy; to differentiate it with certainty from other shrinking processes is usually difficult. Chronic shrinking tuberculosis, syphilis, chronic pleurisy and empyema, chronic partial bronchial stenosis may all convert a lung into a system of sacculations which may be difficult or well-nigh impossible to distinguish from cystic disease. The absence of tubercle bacilli, the absence of pleurisy or empyema, may help to corroborate suspicion. Patients often date the beginnings of their disease from an acute respiratory infection. This is neither here nor there, for congenital cysts will often remain latent until infected by an intercurrent influenza or similar respiratory disease.

The radiological manifestations of infantile cystic disease have already been described. A solitary cyst may cast a round mediastinal shadow or appear as an air-containing cavity lying either in the mediastinum or in the pulmonary parenchyma. Lipiodol may at times flow into the cysts and puddle at the bottom, producing a movable fluid level. At times it may be impossible to introduce the oil into the cavity; however, the normal bronchi roundabout, when seen in the stereoscopic view, may fill and delineate its contours in negative outline.

X-ray films of more extensive cystic conglomerates show a curious system of whorls, occupying usually the lower part of a lung field (Cases 4 and 6). These usually fill more or less well with lipiodol.

Cystic degeneration of a whole lung is often masked by a contracted gray hemithorax, with a deviated mediastinum. Overexposure may succeed in bringing out some detail through the shadow. Lipiodol will usually demonstrate extensive sacculations occupying more or less the entire lung. It may be quite impossible to judge, either clinically or radiographically, whether these extensive sacculations are congenital or acquired. Acquired chronic bronchial stenosis may lead to shrinkage of the pulmonary parenchyma and dilatation of the end branches of the bronchial tree that are indistinguishable from congenital deformities.

Case 7. J. S., a millworker, aged 51, was referred by Dr. J. H. Kuser, of San Rafael, on Sept. 7, 1927. He had been operated on for a large hydrocele in July, 1926. Following the operation he had a large hematoma but recovered and went back to

work. He stated that he had been subject to "colds" ever since his operation, and three weeks after the operation he began to have sweats. In January, 1927, he had a pulmonary hemorrhage and left work. He had fever, much cough, and purulent expectoration in which no tubercle bacilli were ever found. X-ray examination by Dr. H. E. Ruggles and Dr. Lloyd Bryan in January, 1927, showed a fan-shaped grayness of the right upper lobe. In August, 1927, the whole lobe was honeycombed with large cavities, found at operation. After a half-year in the hospital the man died of profuse pulmonary hemorrhage and an acute pneumonia in the right lower lobe. At autopsy, the whole right upper lobe was found to be replaced by a cavernous system of large bronchiectatic pouches. The right middle lobe had been operated upon and was open and clean, but before operation it also had been the seat of extensive bronchiectases.

Although the late films and the autopsy might lead one to suspect congenital changes, the history and the early films prove that the man was suffering from post-operative abscesses of the upper and perhaps the middle lobes, both of which were later converted into a system of huge cavities almost totally replacing the normal parenchyma.

This is but one of a series of similar observations of deformities produced by suppurative lesions which in their end-effects are indistinguishable from congenital malformations.

Without early X-ray films and a definite history, the origin of others is obscure. Thus a spinster of 53 years (Case 8), referred by Dr. P. K. Brown, dated the onset of her disease from an attack of measles at the age of 14. At this time she had a cough that lasted a year. She was supposed to have been tuberculous. For the next forty years she coughed and expectorated such large amounts of foul sputum that she finally shunned all human society and settled down to the life of a recluse on a small chicken ranch. She had had many attacks of fever and pneumonia. X-ray examination revealed enormous bronchiectatic puddles in the left lower lobe. Her cough and expectoration cleared after lobectomy. After closure of the resulting bronchial fistula she was restored to her former friends and relatives in good health.

Figure 21 shows a section through the base of two lungs with large round cavities that have been injected with a barium sulphate gelatin mixture. They are probably, but not certainly, congenital. Microscopically one saw considerable ulceration of the bronchial mucosa, extensive submucous inflammatory infiltrates, and considerable areas of carbon deposits between the cavities, findings which, according to Sauerbruch and Lotzin (1), speak against a congenital origin. However, the patient gave a history of cough and colds since early childhood. At first she had fever only in the winter; later she suffered from fever and chills every few months. She had a profuse, grayish, purulent sputum which was never foul.

More localized lesions are more easily distinguishable. Chronic tuberculous caseation and chronic encysted localized tuberculous empyema may give rise to similar radiograms; so also may true lung tumors. Tuberculosis, however, will scarcely ever be so strictly local and not show lesions elsewhere in the lung, while true tumors will sooner or later, if not immediately, reveal their nature.

The bronchoscope is of inestimable value not only in determining the seat and nature of congenital lesions but in the treatment of many of them. Bronchoscopy, revealing anomalies of bronchial distribution, will occasionally allow of a positive diagnosis of congenital malformation that neither clinical observation nor the X-ray can establish.

Clinical observation, the X-ray, and the

bronchoscope will, I am sure, unearth much congenital cystic disease that has hitherto escaped observation, and in this triple alliance the X-ray perhaps will play the major rôle.

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THE BONE AND JOINT CHANGES OF LEPROSY: A ROENTGENOLOGIC STUDY[1]

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IT has been known for many years that remarkable changes occur in the bones in leprosy. These changes are usually most marked in the extremities and consist of absorption, rarefaction, or destruction of one or more bones of the hands or feet, with resultant deformity or shortening of fingers or toes. It has been our opportunity to examine a fairly large number of cases, and the fact that no such series has as yet been presented in American roentgen literature suggested that its publication might be of interest. Originally, one hundred and fifty cases, either suspected of or known to have leprosy, were examined with a view to ascertaining whether or not some slight change in the roentgen appearance of the bones might be of assistance in the early diagnosis of the disease (N. E. W.). Certain variations were noted, but comparison with a group of known normals demonstrated that these were of no significance. We were unable to discover any early bone change pathognomonic of leprosy.

Clinically, leprosy has been divided traditionally into the nodular or cutaneous and the anesthetic or nervous type, but it is now fairly generally accepted that most cases show lesions of both kinds, though, of course, one or the other may predominate in the clinical picture. Like tuberculosis, leprosy may be purely a local condition; but again, like tuberculosis, it often manifests itself in many different ways and in various regions of the body, though with a remarkable selectivity for the peripheral nerves. Bacteriemia is probably a fairly common occurrence and this presumably accounts for

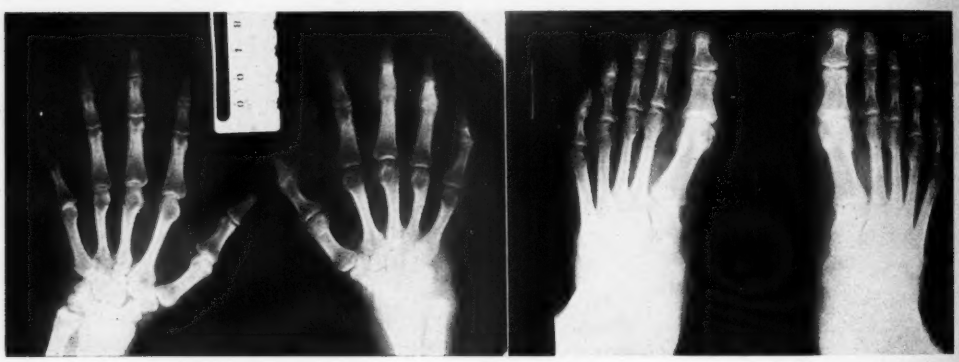

Fig. 1-*A (left)*. Slight "narrowing" of tips of distal phalanges of each fifth finger. "Notching" of distal phalanx, right third finger.

Fig. 1-*B (right)*. Slight irregularity and possible "narrowing" of tips of distal phalanges of many of the toes.

[1]Read before the Sixteenth Annual Meeting of the Radiological Society of North America, Los Angeles, Dec. 1–5, 1930.

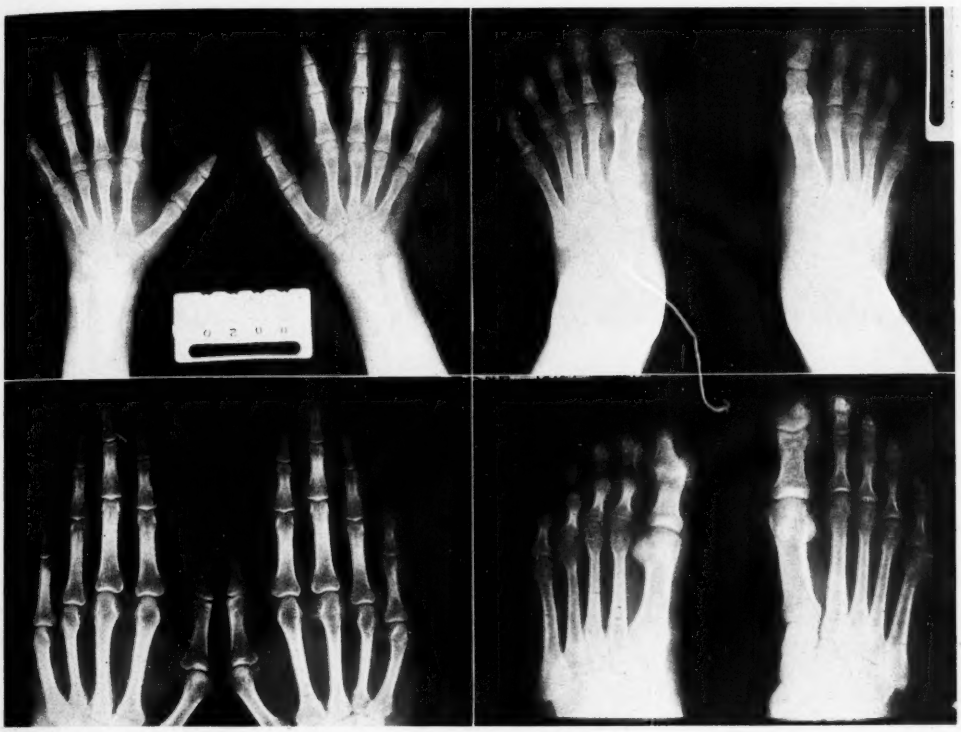

Fig. 2-*A (upper left).* Early "narrowing" of the distal phalanges, most evident in the first and fifth fingers of both hands. Note the presence of subcutaneous nodules.

Fig. 2-*B (upper right).* "Narrowing" of the distal phalanges, especially of the second toes.

Fig. 3 *(lower left).* "Notching" of the distal phalanx of the right second finger.

Fig. 4 *(lower right).* Marked "narrowing" of the distal phalanx of the left first toe.

the symmetrical and bilateral distribution of the lesions which is sometimes seen. It is a surprising fact that clinically advanced cases will often show little or no osseous disturbance, while cases with merely mild clinical signs may show marked changes upon roentgen examination. Cases of the latter type show predominantly nervous lesions in many instances.

Normal Anatomy.—Prior to the consideration of leprous bone lesions, the normal roentgen appearance of the hands and feet was studied in detail by reviewing the roentgenograms of one hundred clinically normal individuals. The importance of this became apparent when we discovered that many of the appearances which we at first thought abnormal were, in fact, manifestations either of normal variations or technic. The following variations must be borne in mind:

Hands.—Slight narrowing or even absence of the tufts of the terminal phalanges is not very unusual. By "absence of the tuft" is meant lack of usual broadening-out of the tip; the trabeculæ may be quite differently arranged from those of the shaft, but a true "tuft" is absent. Tiny notches near the apex and flattening of one side of the tuft are not uncommon; frequently the latter is a misleading appearance due to rotation of the finger tip. True U- or V-shaped notching of the tuft apex, centrally, is usually definitely abnormal. "Tenting" or pointing of the tip, and an appearance as

Fig. 5 *(upper left)*. Irregularity and "narrowing" of the distal phalanges of both first and second toes.

Fig. 6 *(upper right)*. "Narrowing" of distal phalanx, right third finger; "notching" of distal phalanges, right first and second fingers, and left fourth finger; destructive arthritis, right third distal interphalangeal joint.

Fig. 7 *(lower left)*. "Complete absorption" of distal phalanges, left second, third, and fourth toes, and right fourth toe. Atrophic changes, proximal interphalangeal joint, left third toe.

Fig. 8 *(lower right)*. Irregular absorption of shaft, right fifth metatarsal. Bony ankylosis, proximal interphalangeal joint, right third toe.

though one side had been "sliced off" is also abnormal (8). Slight flexion of the fingers gives rise to numerous artefacts, including an appearance very suggestive of arthritis or ankylosis. The diaphyseal portions of the longer bones, especially of the metacarpals in women with slender hands, may appear so narrow as to be almost indistinguishable from the "concentric atrophy" of leprosy.

Feet.—Irregularities of the tips and shafts of the terminal phalanges of the feet are almost the rule. Perfect tufting, as seen in many hands, is almost the exception. As in the hands, however, V-shaped notching or pointing of the tips should always be looked on with suspicion. Fusion of the middle and distal phalanges of the fifth toe is quite common; a similar condition in the fourth toe is not rare. Slender metatarsals in females and a few males are seen; by taking oblique and lateral views the diaphyses, however, are often seen to be quite "thick" and readily distinguishable from "concentric atrophy."

ROENTGEN FINDINGS IN LEPROSY

The most striking osseous change in leprosy is the gradual absorption of a bone

from its surface without associated rarefaction. As Harbitz (4) has said, "the bone appears to melt away"; decalcification is peripheral and no demineralization in the ordinary sense of the word is seen. When this absorption involves a whole shaft, the spectacular change called "concentric atrophy" is seen (see Figs. 12, 13, 17). Other manifestations of the same process are described as "narrowing" (Figs. 1-*A*, 2-*A*, 5), "pointing" (Figs. 2-*A*, 4, 13), and "notching" of bones (Figs. 3, 6, 10-*A*), and irregular absorption of shafts (Figs. 8, 9, 17). "Shaving off" of one side of the tip of a terminal phalanx is said to be characteristic (8), but was not observed in this series.

The most advanced stage of absorption is followed by complete disappearance of the bone, usually with shortening of the digit and other deformities (Figs. 7, 11, 13); in rare instances the shape of the soft parts may be preserved, with little outward evidence of the osseous changes beneath.

Besides bone absorption, actual bone rarefaction, sometimes diffuse, more often localized, is seen in leprosy (Figs. 6, 9). Periosteal thickening may be present along with this osteal change, but, in the absence of secondary infection, it is not very common (Figs. 8, 11, 14, 16). Periosteal thickening of the long bones near the ankle and wrist joints has been reported in one or two instances (6) (see Fig. 14-*C*).

Joint involvement is common, usually occurring along with fairly well marked erosion of the adjoining bone—though without demineralization as commonly seen in coccic arthritis (see Figs. 11, 12, 13). In

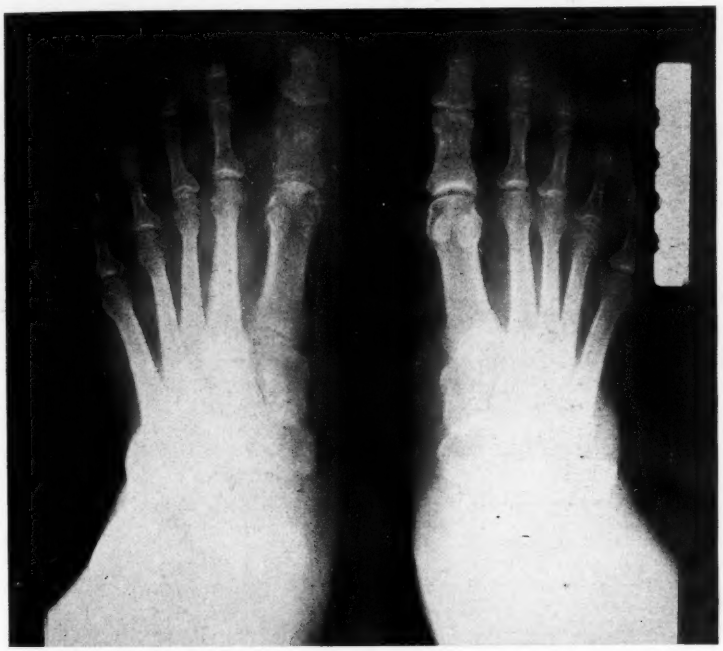

Fig. 9. Rarefaction and absorption of distal end of proximal phalanx of right first toe—no collapse of soft tissue parts.

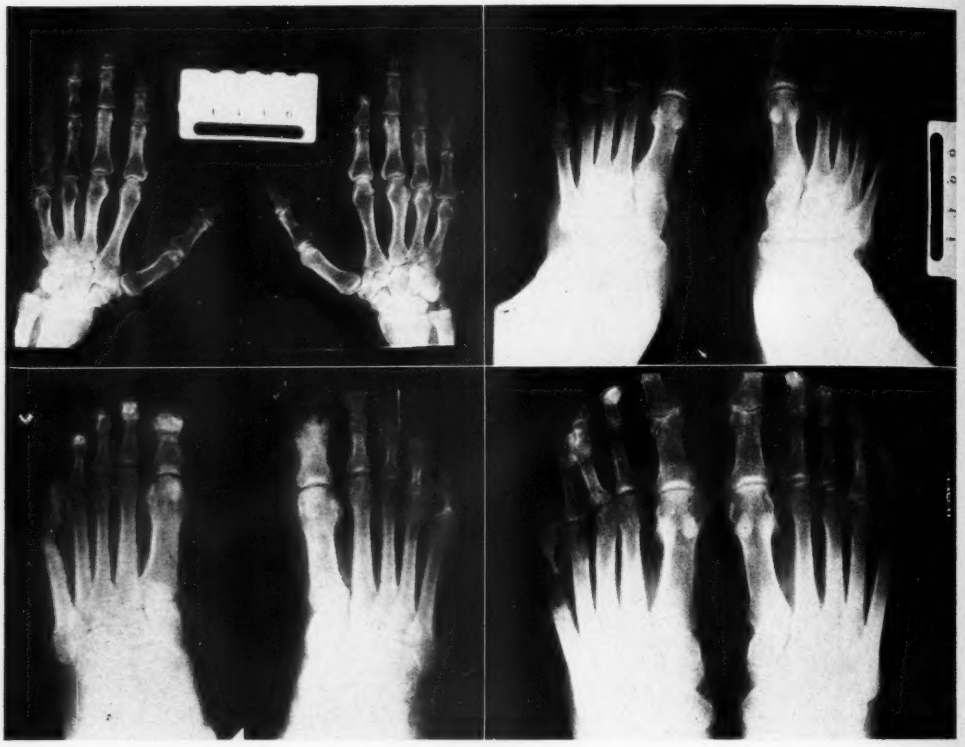

Fig. 10-*A (upper left)*. "Notching" of distal phalanx, left first finger. Irregular absorption of proximal phalanx, left fifth finger. Destructive arthritis of distal interphalangeal joint, right fifth finger. Partial absorption and flexion of distal phalanx, right second finger.

Fig. 10-*B (upper right)*. Partial absorption of distal phalanx, left second toe. Irregular destruction, distal end of left fifth metatarsal. "Shaving off" of base of proximal phalanx, left fifth toe.

Fig. 11 *(lower left)*. Complete absorption of distal phalanges, right second and third toes. Irregular destruction of distal phalanx, right first toe. Partial absorption of many of the remaining distal phalanges. Destructive arthritis left fifth metatarsophalangeal joint and right fifth proximal interphalangeal joint. Periostitis of shaft, left fifth metatarsal.

Fig. 12 *(lower right)*. "Concentric atrophy" of proximal phalanx, left fifth toe. Destructive osteitis, left fifth metatarsal. Destructive arthritis, left third metatarsophalangeal joint. Ankylosis of middle and proximal phalanges, right fourth toe.

advanced cases disorganizing arthropathy of the Charcot type is occasionally seen. Bony ankylosis, often of a remarkably perfect nature, appears to follow some of the earlier joint lesions (Figs. 8, 12, 17).

Along with other late manifestations, fractures, dislocations, and even protrusions of "awl-point" phalanges through the cutaneous tissues may occur.

Definite cysts, as reported in the literature (2, 5), were not seen in any of the bones of the hands or feet in this series. There was one case with marked periosteal thickening of the lower end of the radius, which disappeared after a year, and which may well have been specific (Fig. 14-*C*). Except for this instance, no evidence of involvement of the long tube bones was seen; the spine and skull have never been known to show leprous lesions.

In the series of 28 cases selected for the purpose of illustrating the present paper, the

above-described pathologic changes occurred with the following frequency:

Bone absorption of various types	23 (plus 3 doubtful cases)
"Narrowing" of tips—commonly the terminal phalanges	18 (plus 2 doubtful cases)
"Pointing" of tips	9 (plus 1 doubtful case)
"Notching" of tips	6 (plus 2 doubtful cases)
Irregular absorption of shafts	17 cases
"Concentric atrophy"	14 (plus 2 doubtful cases)
Complete absorption of bones	7 cases
Bone destruction or rarefaction	16 (plus 1 doubtful case)
Localized—leprous osteitis (?)	14 (plus 1 doubtful case)
Diffuse	5 cases
Periostitis—possibly specific	7 (plus 1 doubtful case)
Joint involvement	18 cases
Atrophic or destructive arthritis	18 cases
Bony ankylosis	7 cases

PATHOLOGY

The gradual shrinkage of the bones or bone atrophy of leprosy is believed to be due to disturbed nutrition following involvement of the nerves, either by inflammation or infiltration. The atrophy may start at the tip and slowly progress proximally, with subsequent diaphyseal narrowing; or it may start in the epiphyses near the joints, involving the proximal and not the distal phalanges. Deycke (2) believes that there is no true specific process involved, but that secondary resorption and decalcification occur on a "trophoneurotic basis." These trophic phenomena follow "continuous irritation rather than total destruction of the nerves." Kaufmann (7) maintains that "neurotrophic" lesions have not been proved as a pathological entity, but he himself attributes the changes to a "neurotic" disturbance and calls the appearance "neurotic atrophy."

Besides the actual neurotrophic factor, mechanical and inflammatory influences apparently play a considerable part. Muscle spasm and also the actual weight of the body (4) influence the deformities present, and repeated trauma must play some part; hence, the feet are usually much more badly affected than the hands. When cutaneous ulceration occurs, secondary pyogenic infection is common. We agree with Deycke that no productive osteal or periosteal lesions occur in "uncomplicated nerve leprosy."

The localized rarefactions and some, at least, of the joint lesions are due to specific bacillary invasion. Bacillus-containing leprous nodules appear in the bone-marrow producing focal caries and secondary periosteal changes (7). Deycke (2) believes that nodular leprosy does not often affect the bones but that, when it does, multiple osseous lepromas occur; we believe this is correct. Leprous nodules are found in the spongiosa, especially of the phalanges; these nodules resemble tuberculous granulomas, but are more vascular and do not show giant-cells; the latter are represented by "lepra cells"—large mononuclear macrophages. Spindle-shaped swellings similar to spina ventosa of tuberculous or syphilitic origin may occur.

DIFFERENTIAL DIAGNOSIS

Innumerable conditions may, unfortunately, cause a roentgen appearance similar to that of leprosy, especially in its earlier or milder forms. These include the more common infectious processes; vascular disturbances such as Raynaud's disease, endarteritis obliterans, and arteriosclerosis; nervous lesions such as peripheral neuritis,

tabes dorsalis, and syringomyelia; also rare lesions of the bones occurring in scleroderma, exophthalmic goiter, and arthropathic psoriasis. In practice, the more common infectious processes rarely cause con-

and metatarsals are rarely evident. Arthritic changes and ankyloses are uncommon (9).

Endarteritis Obliterans and Arteriosclerosis.—These diseases may very occasionally produce a roentgen appearance identical with

Fig. 13. Complete absorption of middle and distal phalanges, left second and third toes. "Concentric atrophy" of proximal phalanges, left second and third toes. Destructive arthritis of proximal interphalangeal joint, left fifth toe, and of metatarsophalangeal joint, right fifth toe.

fusion but the vascular (ischemic) and nervous lesions, mentioned above, may cause changes distinguishable from those of leprosy only on clinical or bacteriological grounds.

While the differential diagnosis from the roentgenograms alone is, therefore, difficult, if not impossible, the following points may be of help in some cases:

Raynaud's Disease.—The phalangeal lesions are similar to those of leprosy, but absorption and destruction of the metacarpals

that of leprosy (Fig. 18). When this occurs, the differentiation must be on clinical or other grounds.

Peripheral Neuritis.—This is mentioned in the literature as a cause of small bone atrophies and absorptions. We have observed no definite cases.

Tabes Dorsalis and Syringomyelia.—The clinical features of these diseases are usually obvious. In the absence of clinical information, differentiation may be difficult or impossible (Fig. 18). In syringomyelia the le-

Fig. 14-*A (left)*. Partial absorption, with osteal and periosteal changes, first metatarsal. Partial absorption, proximal and distal phalanges ("notching") of first toe.

Fig. 14-*B (right)*. Same patient as Fig. 14-*A*, four years later. Further absorption of proximal and distal phalanges and of metatarsal, right first toe. Destructive arthritis of right fifth metatarsophalangeal joint. Periostitis of fourth and fifth metatarsals. Curving of outer four metatarsals, possibly due to softening (osteomalacia).

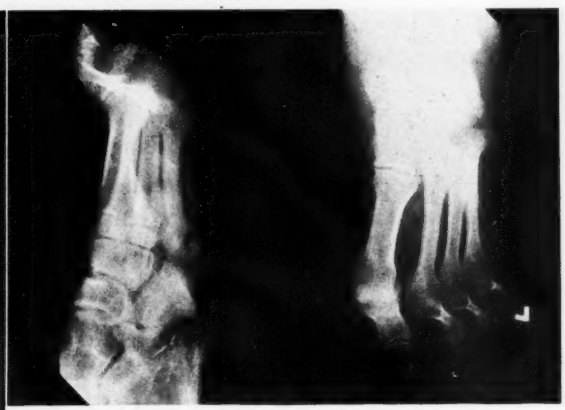

Fig. 14-*C (left)*. Periosteal thickening about lower end of radius, with some diaphyseal rarefaction, possibly leprous.

Fig. 15 *(right)*. Advanced absorption of the fifth metatarsal and the phalanges of the fifth toe. Partial absorption of phalanges of third and fourth toes.

sions rarely or never affect the feet, and in tabes, rarely or never the hands.

Sclerodcrma.—Small calcified spots, "calcareous deposits," occur in the finger tips along with the phalangeal absorptions of this disease (3); so far as is known, these

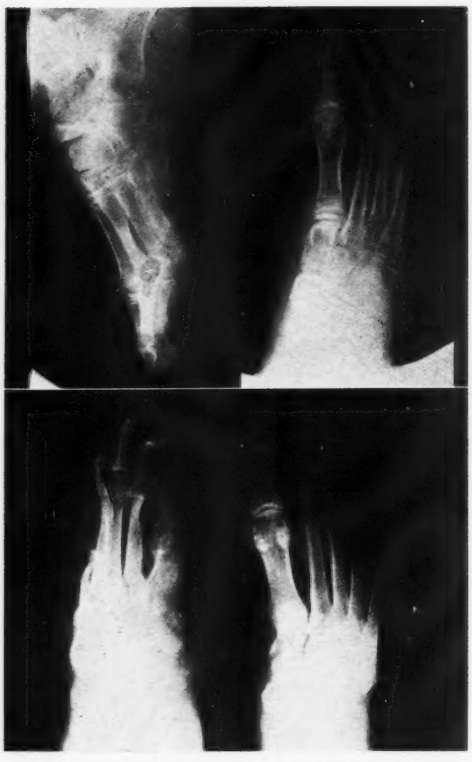

Fig. 16 *(upper)*. Absorption of distal phalanges of fifth metatarsal. Periostitis of fourth metatarsal. Destructive arthritis of metatarsophalangeal joint, fourth toe. *Note:* Whether the narrowing of the scaphoid is due to leprosy or to non-specific osteochondritis is uncertain.

Fig. 17 *(lower)*. Irregular absorption of left first metatarsal. "Concentric atrophy" of remaining left metatarsals, most marked in fifth. "Concentric atrophy" of many phalanges, left foot. Ankylosis of metatarsophalangeal joint, left fourth toe. Periostitis of left second metatarsal.

Fig. 18. Male, aged 51, with tabes dorsalis and advanced lumbar spine osteo-arthropathy of the Charcot type. Clinically definitely syphilitic; negative for leprosy. Note the destructive bone and joint changes in the first toe, the periostitis of the second and third metatarsals, and the ankylosis of the proximal interphalangeal joint of the second toe.

do not occur in leprosy, though it must be noted that nodules of similar nature were found in the ears of one of our cases.

As examples of the difficulties of differential diagnosis, we illustrate a case of Raynaud's disease, associated with endarteritis obliterans (Fig. 19), and a case of tabes dorsalis (Fig. 18), in which the roentgen findings were strikingly similar to those of well-established bone leprosy.

SUMMARY

Bone and joint changes of a remarkable and sometimes spectacular type occur with fair frequency in leprosy.

Bone absorption (disappearance of bony tissue without antecedent demineralization) is the most constant finding: this varies from slight metaphyseal narrowing to diffuse diaphyseal absorption ("concentric atrophy"). Complete disappearance of a bone may occur. The absence of bone production is a conspicuous feature. It is probable that the absorptive changes are not specific, but are produced indirectly through nerve involvement.

Bone destruction with rarefaction is a less common finding. When present, it is believed to be due to specific leprous osteitis, though secondary pyogenic infection may play a part.

Periostitis sometimes occurs. In the absence of secondary infection it is believed to be specific.

Joint involvement occurs almost as frequently as "bone absorption." Destruction is the striking feature, but a spectacular type

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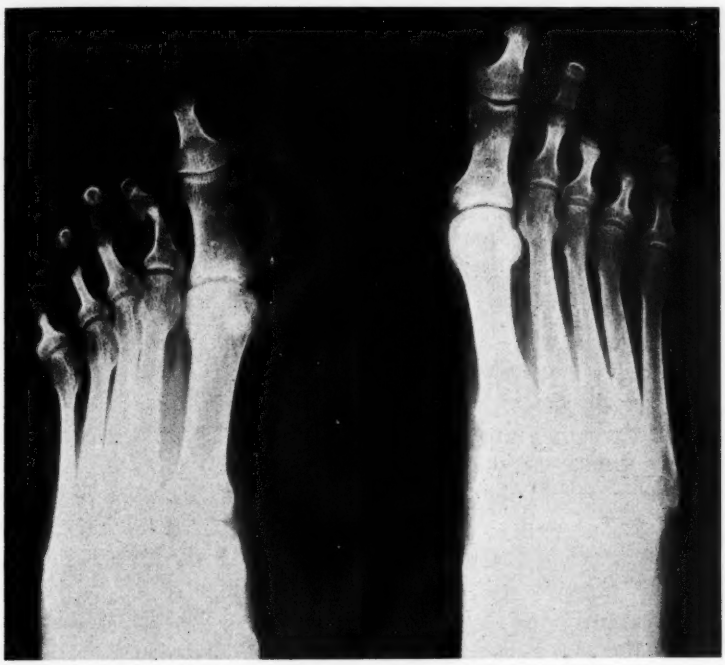

Fig. 19. Male, aged 43, with endarteritis obliterans of lower extremities, and possible Raynaud's disease, both of five years' duration. Transabdominal sympathectomy without relief. Clinically and bacteriologically negative for leprosy. Note the "concentric atrophy" of the proximal phalanges of the outer four left toes, with various other absorptive changes similar to those of leprosy.

of ankylosis (bony fusion, with little or no shortening) may occur.

The present paper is primarily a presentation of illustrations of the more important types of leprous lesions in the bones and joints, with notes upon the pathology and differential diagnosis.

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ROENTGENOLOGIC EVIDENCE OF CHEST TUBERCULOSIS IN TUBERCULIN-POSITIVE AMBULATORY CHILDREN[1]

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IN clinics for children and in doctors' private offices there are always a large number of ambulatory children who are suspected of being tuberculous, either because of vague symptoms or because of some contact with a tuberculous person. It happens very frequently that, after a careful history has been taken and a thorough physical examination completed, the doctor is still in doubt as to the cause of the child's condition. The physician must decide what further steps should be taken to establish a diagnosis.

The current literature gives abundant proof that the diagnosis of even serious tuberculous lesions frequently cannot be made on the subjective symptoms, the physical signs, and the history. In a recent study of a series of tuberculin-positive children, Wolff, Stone, and Eberson (1) concluded that symptoms and physical signs are not conclusive, and that a history of definite contact is of rather limited value. Chadwick (2) states: "Many children have the childhood type of tuberculosis without manifesting any symptoms that can be ascribed to the disease, although they may have a progressive lesion," and, later, "A diagnosis of some phases of the childhood type of tuberculosis cannot be made by physical examination." Opie (3), in an excellent review of the subject, states: "Extensive studies . . . have demonstrated the widespread occurrence of grave tuberculous lesions in the lungs of children who do not seem to be sick and in many instances are well nourished and apparently in robust health."

The tuberculin reaction has stood the test of time as a means of definitely establishing whether or not a child of the type here considered has a tuberculous infection. Opie *(loc. cit.)* states: "In children able to attend school, failure to react to tuberculin indicates the absence of infection with tuberculosis," and then he gives the few exceptions to the rule. Hence the physician's next step in examination is the tuberculin test.

However, if the child reacts positively it does not necessarily mean that he has an active tuberculous lesion. It is at this point that the roentgenologic examination of the chest becomes useful. It is frequently stated that every child with a positive tuberculin reaction should have an X-ray examination of the chest. Inasmuch as a high percentage of children, especially over 10 years of age, give a positive reaction, many physicians wonder whether they are justified in requesting a roentgenologic examination of all such cases. To determine the value of this examination in a particular clinic is the object of this study.

MATERIAL

The material used was drawn from the Children's Chest Clinic of the University of California Medical School. It consisted of 93 tuberculin-negative and 197 tuberculin-positive children who were ambulatory and had no marked symptoms. They came to the clinic because they were suspected of having a tuberculous process or because they had been exposed to tuberculosis. The average age of the negative and positive groups was eight and one-half and nine years, respectively.

The tuberculin test consisted of the intracutaneous injection of 0.1 c.c. of 1:100 human tuberculin (O.T.) and of a broth con-

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trol. The reactions were observed and measured at 48 hours. The diameter of the infiltration was recorded in centimeters. Because a former study (1) had shown that the extent of the tuberculin reaction was of definite value, the positive reactors were divided into four grades as follows:

Grade I	38 Cases	19%	0.5 to 0.9 cm.
Grade II	28 Cases	14%	1.0 to 1.4 cm.
Grade III	26 Cases	13%	1.5 to 1.9 cm.
Grade IV	105 Cases	54%	2.0 or more cm.

ROENTGENOLOGIC FINDINGS

In the literature there is a seemingly hopeless disagreement as to what structures cast shadows and what shadows can be interpreted as due to tuberculosis. For that reason a preliminary study of the chests of tuberculin-negative children was undertaken. The interpretation of the various findings is given in a previous paper (4). The accurate studies of McPhedran, Armand-Delille, Stierlin and Chaoul, and Engel, quoted in that paper, appeared to be bringing some order out of the chaos. A recent work on children's chests (5), which seemingly ignores the general conclusions of these various investigators, brings to the fore again the same confusion. It seems advisable, therefore, to restate briefly and dogmatically the most important points.

The hilar shadow is cast by the main stem arteries, veins, and bronchi. Paratracheal and hilar lymph glands show only when calcified or so enlarged as to extend beyond the normal shadows and come in contrast with the lung. Dense, round or oval shadows of homogeneous density are almost always due to vessels axially radiated, and not to calcified nodes. Calcified nodes are granular or laminated, and irregular in outline. The greatest single difficulty lies in interpreting these dense hilar shadows, especially in films with even slight motion. Indefinite enlargement of the hilum and the indistinctness of its structures is usually, if not always, due to vessel pulsation and vibration. This makes any interpretation of fibrosis at the hilum very difficult. Beading or studding of the linear markings, seen especially in the upper lobes, is usually due to branching vessels. In normal subjects the interlobar pleura between the right middle and lower lobes is frequently shown as a thin line (6).

For the present study the postero-anterior and lateral films of each case were carefully analyzed, and the size, shape, position, and consistency of each of the following shadows listed:

Each Hilum	*Each Lung*
Calcification	Calcification
Fibrosis	Fibrosis
Axial Vessels	Axial Vessels
Glandular Tumor	Infiltration
Unusual Density	Unusual Linear Markings

Pleura
Increased Density
Calcification

Because some of these patients were first studied eight years ago, the technic of the films leaves much to be desired. At present the exposures are made in one-twentieth of a second at six feet. Better results could without doubt be obtained by synchronized films (7). Inasmuch as most laboratories are not equipped for this type of exposure, the films used for this study are such as can be duplicated in many clinics.

By comparing the roentgenologic findings in the tuberculin-negative (4) and tuberculin-positive groups, some opacities were discovered in the tuberculin-positive group which were not present in any of the tuberculin-negative cases. These findings are regarded as diagnostic of tuberculosis and will henceforth be called positive roentgen evidence. They correspond with those gen-

erally recognized in the literature as due to tuberculosis. Calcifications in the hilum are always the result of tuberculous infection. If the calcification is advanced, it usually shows as a dense, sharply defined shadow; if early, as a more granular, less definite, opacity. Caseous glands, so enlarged that the resultant tumor projects beyond the vessels, will show. These hilum tumors in tuberculin-positive children, with no evidence of such lymph gland diseases as Hodgkin's, can be considered tuberculous. Rarely do glands enlarged from other infections show on the films. Small isolated nodules in children's chests, which show when calcified or when of fairly large size, are due to tuberculosis; however, they may be present as small caseous foci and not show. Some cases in the present series have shown lymph gland involvement with no lung lesion evident in the region drained by the gland. Months later a small nodule has been demonstrated in that suspected area. A re-study of the earlier films has failed to reveal any indication of this lesion, though it must have been present.

Lung infiltrations due to tuberculosis are generally characteristic. In the presence of a positive tuberculin reaction, these infiltrations can be considered as tuberculous. McPhedran (9) has given a most comprehensive description of these and, therefore, no further discussion will be given here. The value of the roentgenographic examination in these cases is not limited to diagnosis only. In many cases physical signs are entirely lacking and the only method of following the evolution of the process is by serial films. Many of the cases included in the present series have been followed for some years and the exact type of the infiltration established by this means.

Pleural findings are not included in this report as positive evidence. The only pleural finding that was frequent was a demonstration of the interlobar pleura on the right, between the middle and upper lobes. This was found in 27 cases, 14 per cent of the total, but it was also found in 12 cases, 13 per cent, of the tuberculin-negative group. Diaphragmatic adhesions were found in 11 cases—but they can be caused by many other inflammatory conditions. A definite calcification of the pleura was found in two cases, but in both it was associated with definite pulmonary tuberculous lesions and, therefore, would not change the statistics.

Because the diagnosis in other organs does not present the same clinical or roentgenologic difficulty, no consideration has been given here to the tuberculous lesions of other organs of the cases in this series.

The various positive roentgenographic findings observed in the present series are shown in Table I. Hilum calcifications were found in 24 per cent, hilum tumors in 5 per cent, lung nodules in 22 per cent, and lung infiltrations in 14 per cent.

Of the whole group, 42 per cent were found to have positive evidence of tuberculosis of one type or another. The percentage of positive findings is greater in proportion to the size of the tuberculin reaction, increasing from 13 per cent in those with the smallest reaction considered to 57 per cent in those with the largest. This increase holds good in general for each particular finding. These results are in general agreement with those of Hetherington, McPhedran, Landis, and Opie (8) on school children.

It is generally agreed that the primary complex in children consists of a lesion in the lung, plus an involvement of one or more lymph nodes at the hilum. When these heal they become fibrotic, and, if caseation has taken place, they calcify. In Table I, it is shown that 48 cases were found to have hilar glands calcified, and 45 cases had a fibrotic or calcified spot in the lung parenchyma; but an analysis of the cases shows that in only 24 were these lesions found together. It seems likely that several lung spots were not demonstrated because they

TABLE I.—SUMMARY OF ROENTGENOGRAPHIC FINDINGS

Grade of Tuberculin Reaction	Cases	Cases with Positive Findings		Hilum Calcification		Hilum Tumor		Lung Nodules, Fibrotic or Calcified		Lung Infiltration	
		No.	%	No.	%	No.	%	No.	%	No.	%
I	38	5	13	4	10	2	5	3	8	0	0
II	28	9	32	3	11	0	0	5	18	2	7
III	26	10	38	7	27	2	8	5	19	1	4
IV	105	60	57	34	32	7	7	32	30	26	25
Total	197	84	42	48	24	11	5	45	22	29	14

lay behind tissues of greater density, such as the liver and heart, and that several hilar and mediastinal calcifications were missed because oblique projections were not made routinely.

The most important fact that Table I brings out is the comparatively large number of lung infiltrations demonstrated in these ambulatory children. It is also important that all but three of these cases fall in the group giving a tuberculin reaction of greater diameter than 2 centimeters. The severity of these lesions can be gauged from Table II, which classifies them according to McPhedran (7). His division "A," focal tuberculosis, is the same as our fibrotic or calcified lung nodule. "B" is a tuberculous consolidation of a lobe or wedge, progressive and unstable. "C" is a tuberculous consolidation of a lobe or wedge, retrogressive and benign. "D" is the diffuse, childhood-type of tuberculous infiltration. "H" is the apical, adult-type of infiltration in children and adolescents. No cases of miliary tuberculosis, "E," were found.

The weakness of this classification lies in the difficulty of deciding into which group a particular case, unless markedly typical, is to be placed at the time of the original examination. However, any case with an infiltration must be kept under close observation, and repeated examinations will reveal the true nature of the lesion. Particular difficulty is found between the "B" and "C" types. McPhedran's (9) full discussion of this classification should be studied by all roentgenologists attempting to interpret children's chest films.

The clinical diagnoses made on these cases without the aid of the X-ray findings are shown in Table III. Whereas a clinical diagnosis of lung infiltration, a serious condition, was made in 15 cases, the X-ray examination showed its presence in 29 cases. Lymph node involvement was diagnosed clinically in five cases, and lymph node tumors were shown roentgenologically in 11 cases. The small focal spots in the lungs

TABLE II.—CASES SHOWING PULMONARY INFILTRATION

	Type of Infiltration				
	A	B	C	D	H
Number of Cases		2	10	14	3

TABLE III.—CLINICAL DIAGNOSIS (CASES)

Grade of Tuberculin Reaction	Tuberculosis of				Non-tuberculous Lung Disease	Clinically Normal Chests
	Lung	Hilum	Pleura	Total		
I	0	0	0	0	14	24
II	2	0	0	2	12	14
III	1	0	0	1	6	19
IV	12	5	7	24	17	64
Total	15	5	7	27	49	121

TABLE IV.—A PERCENTAGE COMPARISON OF THE CLINICAL AND ROENTGENOLOGIC DIAGNOSES

Grade of Tuberculin Reaction	Clinical Diagnosis			X-ray Diagnosis Positive Findings	Percentage Found by X-ray in Excess of Clinical
	Normal Chests	Non-tuberculous Disease	Intrathoracic Tuberculosis		
I	63	37	0	13	13
II	50	43	7	32	25
III	73	23	4	38	34
IV	61	16	23	57	34
Percentage of Total	61	25	14	42	28

and the calcified glands in the hila without gross enlargement cannot be diagnosed clinically with any degree of accuracy.

Table IV shows the percentage relations existing between the three broad groups of clinical diagnoses and the number of positive roentgenologic findings. From this we see that the roentgenologic examination found positive evidence of tuberculosis in many more cases than the clinical examination in every grade-group: 13 per cent in Grade I, 25 per cent in Grade II, 34 per cent in both Grades III and IV, and 28 per cent in the whole group. Only one conclusion is possible; namely, that many cases, often serious cases, will be missed if the roentgenologic examination is omitted.

SUMMARY

In ambulatory children suspected of being tuberculous, the history, symptoms, and physical signs have been found to be insufficient to establish a diagnosis. The reaction to tuberculin proves whether or not there is a tuberculous infection, and the degree of the tuberculin reaction gives some indication of its severity, but it does not indicate the location, extent, or seriousness of the present lesion. Some roentgenographic findings are shown to be diagnostic of intrathoracic tuberculous lesions.

In the present series of tuberculin-positive children, 42 per cent were found to have one or more of these diagnostic shadows. The percentage of such findings was much higher in those cases with the largest tuberculin reaction. A positive diagnosis of intrathoracic tuberculosis was established in 28 per cent more cases by the roentgenographic examination than by purely clinical methods.

Neglecting all other findings, the examination is justified by the fact that the roentgenograms showed 14 cases of serious lung involvement and six cases of extensive lymph gland involvement which were not diagnosed by other means. Inasmuch as all but three of the most serious lesions were found in those cases showing a Grade IV tuberculin reaction, it is most important that the roentgenologic examination be made on all cases showing this grade of reaction. Moreover, this method of examination frequently provides the only means of studying the evolution of these lesions.

CONCLUSIONS

1. The roentgenologic examination of the chest is shown to be of such great value in tuberculous suspects that it should be made routinely on all children with a positive tuberculin reaction.

2. If economic conditions prevent this, it should be made without fail on all cases showing a Grade IV tuberculin reaction because it is absolutely essential in diagnosing serious, otherwise unsuspected lesions, almost all of which are found in this group.

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A COMPARATIVE PHOTOMETRIC DENSITOMETER FOR THE MEASUREMENT OF X-RAY FILM DENSITIES[1]

By CHARLES WEYL and S. REID WARREN, JR., PHILADELPHIA

Abstract.—An apparatus of simple construction and low cost for comparing the density of developed X-ray film with a standard of density is described. The paper is divided into two sections: first, a description of the external mechanical features and method of use of the instrument; second, a detailed description of the various parts of the circuit and their connection and mounting.

GENERAL DESCRIPTION OF THE COMPARATIVE DENSITOMETER

(1) Purpose.—To test the reproducibility of radiographs it is necessary to have a method of comparing film densities. It is convenient to expose the X-ray film through a known thickness of aluminum, the same piece of aluminum being used for each of several exposures investigated. Having taken the radiographs with known kilovoltage, current, exposure time, and focal-film distance, it is necessary to provide a method of measuring the densities of the resulting films.

The density of a film is generally expressed as a relationship of the intensity of light incident upon the film, and the intensity of the light transmitted through the film. The instrument to be described has been designed to measure this density with sufficient accuracy for the problem at hand and may be constructed at a very low cost.

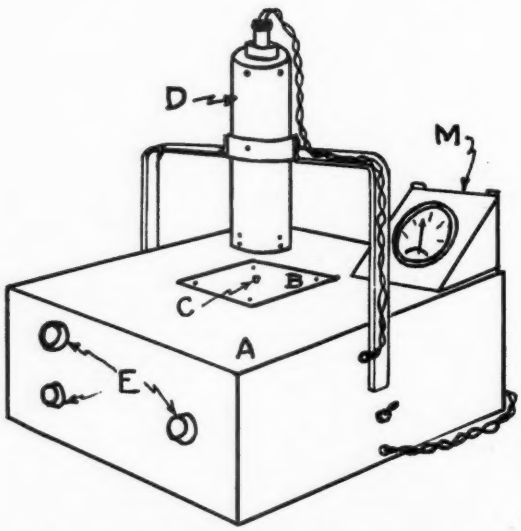

Fig. 1. Diagrammatic drawing of the external appearance of the instrument.

(2) Description and Operation.—The

[1]This instrument was designed at the suggestion of F. Maurice McPhedran, M.D., of the Henry Phipps Institute, Philadelphia. The work was done at the Moore School of Electrical Engineering, University of Pennsylvania, as a part of the program now progressing under a grant by the National Tuberculosis Association.

densitometer consists essentially of a light source with intensity (brilliance) control, a focusing lens, a table to hold the film to be measured, a photo-electric cell which receives the light transmitted through the film, and a vacuum tube amplifier with a meter for indicating plate current flowing in the vacuum tube. This plate current is a measure of the intensity of the light falling upon the photo-electric cell. Figure 1 shows diagrammatically the external appearance of the instrument.

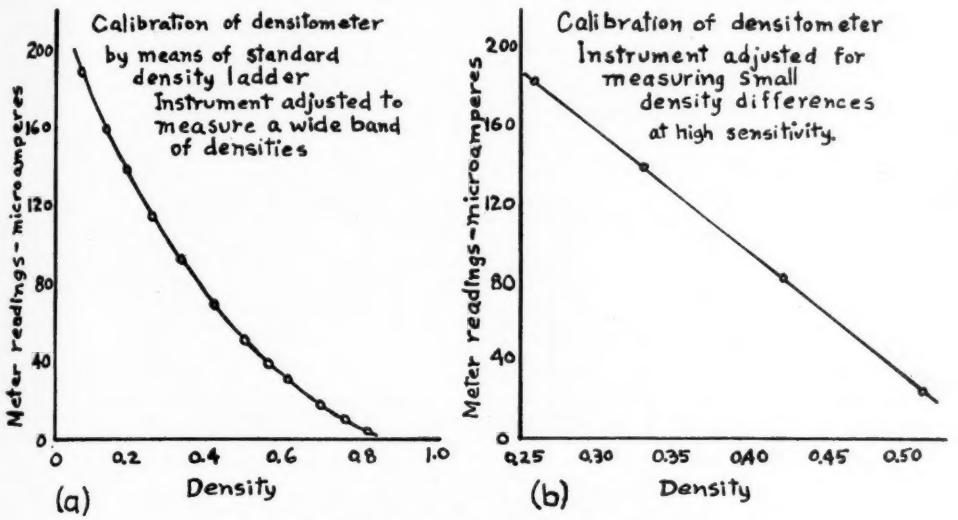

Fig. 2. Curve representing the variation of meter reading with density.

The table (A) is horizontal and is large enough to accommodate a 14 by 17 inch X-ray film. At the center of the table there is inlaid a *black* bakelite panel (B) in which there is a small hole (C). Directly under this hole is the eye of the photo-electric cell. Vertically above the hole the light source and focusing lens (D) are mounted in a brass tube so that a spot of light is focused on the hole in the table. To measure the density of an area of test film, it is held against the hole in the table so that the light passes through the film and into the photo-electric cell. When any light from the source is incident upon the photo-electric cell the circuit is so arranged that the plate ammeter (M), mounted in a convenient place for the operator to see the scale, will deflect from its zero position. Knobs (E) are provided for controlling this deflection. It is convenient to work with deflection near mid-scale (for example, 100 microamperes on a 200 microampere direct current meter). With the test film in place the instrument is adjusted to give a meter deflection of 100 microamperes. Films of which the densities are known are substituted successively for the X-ray film. The standard for which the deflection is 100 microamperes has the same density as the test X-ray film.

(3) Standards—Calibration.—Standards of density may be obtained from the Eastman Kodak Company. For the work for which this densitometer was designed a standard photographic ladder with twelve density steps varying from D = 0.07 to D = 0.82[2] and a second twelve-step tablet

[2]Explanation of "D" is given in Appendix.

from D = 0.27 to D = 2.38 were obtained. The step tablets provided by Eastman are accompanied by a calibration of each of the steps, giving definite values of density.

It will be seen that unless the standards extend over a wide band of densities and unless small changes of densities are given between steps, it will be impossible to obtain an accurate comparison between an exposed film and one of the steps of the standard photographic ladder. A method of interpolation may be applied for measuring densities which have values between successive steps of the standard ladder. The densitometer is so adjusted that the median density of the standard ladder will provide half-scale deflection of the plate ammeter. The standard ladder is then held over the hole in the densitometer table and microampere readings are taken for each step on the standard ladder. Since the density of each step is known, a smooth curve may be drawn on cross-ruled paper representing the variation of meter reading with density (Fig. 2).

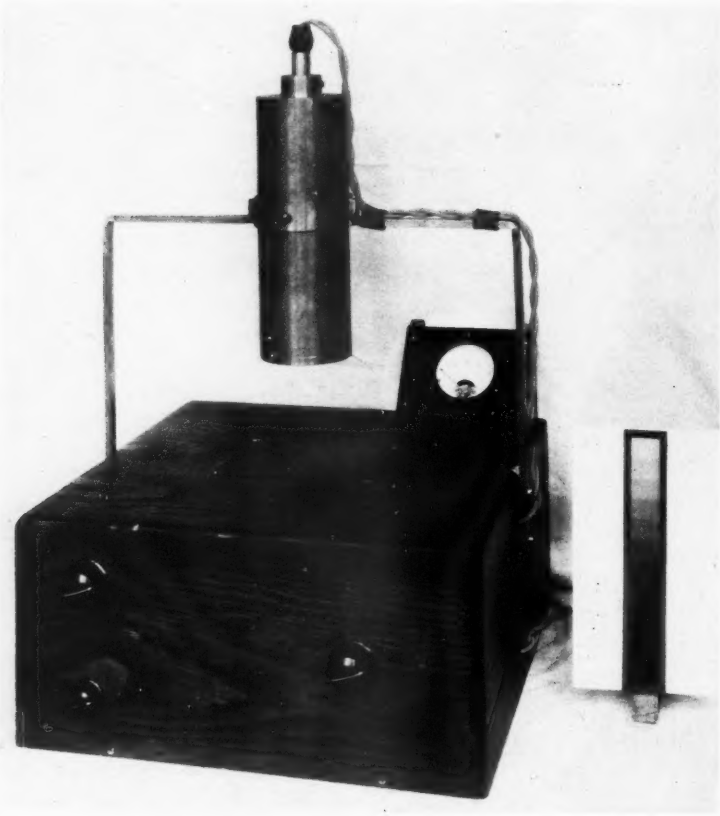

Fig. 3. Photograph of the apparatus.

Then, without changing any controls on the densitometer, meter readings are taken when each of the test films is held successively in the measuring position. With these meter readings the value of density of

each film may be obtained from the calibration curve described above.

The instrument should be calibrated as described in the preceding paragraph each time it is used. The apparatus may be used for measuring a wide band of densities, provided only that the corresponding standards are available.

It is important to note that if two films of different densities are superposed over the hole in the densitometer table, the resultant meter reading will be the reading for the density equal to the sum of the densities of the two films.[3] In other words, densities are arithmetically additive. If an available standard has a maximum density step of 0.82 and it is desired to measure something of density of approximately 1.0, it is only necessary to have available from the test films one with a density of 0.2 (measured in the manner described above), and this may be superposed upon the 0.82 step of the ladder and the resultant meter reading will provide a point on the calibration curve representing D = 1.02.

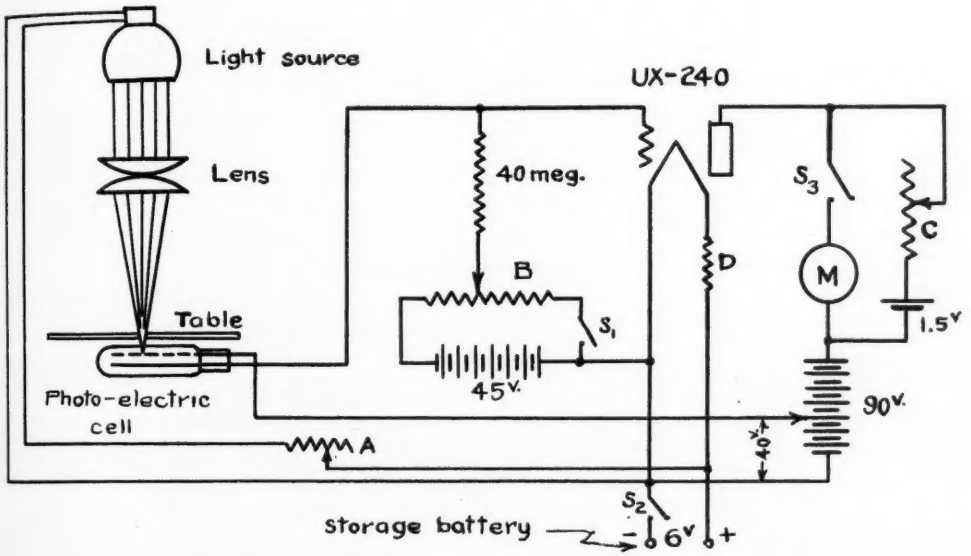

Fig. 4. Circuit diagram of the connections of electrical parts.

Although the instrument was specifically designed for the purpose of comparing radiographic film densities when exposures were made under different conditions, it has many uses in other fields.

DETAILED DESCRIPTION OF APPARATUS AND CIRCUIT

The densitometer as constructed is mounted in a wooden cabinet, the top of which is a horizontal table approximately

[3] See Appendix.

18 inches square. The height of the cabinet is about nine inches. The photo-electric cell and vacuum tube amplifier, including plate batteries, are mounted within the cabinet. Above the horizontal table is mounted a brass cylinder 3 inches in diameter and 9 inches long containing at the top a 21-candle power concentrated filament automobile headlight lamp. A double convex lens 3 inches in diameter, of focal length 5 inches, is mounted at the focal distance from the source at the bottom of the brass tube. The face of the lens is 4½ inches above the top of the table so that the converging beam of light from the lamp is focused in a spot about ⅛ inch in diameter at the surface of the table. A small panel of bakelite is inlaid in the table and a $\frac{3}{16}$-inch diameter hole is drilled in the panel at the point of focus of the light. The photo-electric cell is mounted underneath this hole. The cylindrical surface of the hole should be dull black to provide minimum reflection.

A photograph of the apparatus and a circuit diagram of the connections of the electrical parts are shown in Figures 3 and 4, respectively.

A 6-volt storage battery connected externally is used to heat the filament of the amplifier tube and the headlight lamp used as light source. There are three controls which are mounted on the front of the cabinet. One is a rheostat (A, Fig. 4) connected in series with the lamp and storage battery to obtain various intensities of light; the second is a potentiometer (B) used to vary the grid bias of the amplifier tube to vary sensitivity of the amplifier; the third is a resistance (C) used to balance out the plate current in the meter in such a manner as to permit the adjustment of the position of the needle on the scale of the meter. The meter (M) is a Weston Model 301 with 0-200 microampere scale. It is mounted above the level of the table at the rear of the instrument, providing the operator with full visibility of the entire scale.

The photo-electric cell employed is the Westinghouse "VB," a vacuum cell having very stable characteristics. The vacuum tube used for the amplifier is a Radiotron UX-240. A 40-megohm resistor is connected between the grid and the negative pole of the grid bias battery. Six small 22½-volt B batteries are connected in series, mounted within the cabinet, and are used for B and C voltage supply.

To aid others desiring to construct the densitometer, the exact type of apparatus used has been mentioned in some cases. This does not prejudice in any way the use of equivalent apparatus of other manufacturers.

The simplicity of the apparatus provides that it may be constructed in any small shop which is usually available for roentgenologists and laboratory workers who might desire to build the instrument. The total cost, including a density standard for the particular purpose at hand, should be approximately sixty dollars.

APPENDIX

Photometric Density.—The photometric density (D) of a film is defined by:

$D = \log_{10} I/I'$.

D—Photometric density.

I—Intensity of light incident upon the film, in units of any convenient system.

I'—Intensity of light transmitted through the film, measured in the same units as I.

Since I is greater than I', D is always a positive number. If a film transmits one-tenth the incident light, D = 1.0. The X-ray films obtained from the penetration of ½-inch aluminum with exposures representative of technic used for radiography of parts of the human body will, in general, have density values between D = 0.05 and D = 2.5.

If two films, designated 1 and 2, are

superposed so that light is incident upon 1, the total density D is given by—

$$D = \log_{10} I_1/I_2'$$

The density of Film 1 is

$$D_1 = \log_{10} I_1/I_1' \qquad (1)$$

and the density of Film 2 is

$$D_2 = \log_{10} I_2/I_2' \qquad (2)$$

Adding (1) and (2)

$$D_1 + D_2 = \log_{10} I_1/I_1' + \log_{10} I_2/I_2'$$

or

$$D_1 + D_2 = \log_{10} I_1\, I_2/I_1'\, I_2'.$$

But when the films are superposed in the manner described

$$I_1' = I_2.$$

Therefore—

$$D_1 + D_2 = \log_{10} I_1/I_2'$$

or

$$D = D_1 + D_2.$$

Therefore, photometric densities are arithmetically additive.

CALCULATION OF ROENTGEN DOSAGE[1]

By SANFORD WITHERS, M.D., DENVER, COLORADO

THE most important thing to do after installing a deep therapy equipment is to calibrate the sphere gap. Most X-ray companies supply sphere gaps with a scale calculated at sea level and there are many men throughout the Middle West with installations operating at from 1,000 to 3,000 feet who are not making any attempt to take into consideration the correction for such altitude. I have called attention to this in previous publications (1). (See Table I.)

I have tried various measuring devices in the years gone by in an attempt to calibrate, or at least to determine, the output and erythema dose for various X-ray installations. None of them has been as satisfactory and as "foolproof," as consistent in its readings, as the ionization chamber built for me by Dr. Roy Kegerreis, on which I have made no changes whatever except in the method of charging. This chamber consists of three plates; two negative and one positive, separated 10 mm., the negative plates being the container for the chamber. The plates are connected to a microvolt meter by a suitable metal covered cable which prevents ionization within the cable (2).

This chamber has a filtration corresponding to 0.5 mm. of copper. This is arranged in my installation so that it is indicating ionization current whenever the transformer is energized. The charging current for the ionization chamber is supplied by a Westinghouse 96-volt battery charger, purchased in 1922 for $14.00, which has been giving continuous service since that date. A volt meter was cut into the line so that fluctuation of the impressed voltage could be read at all times. For eight years I have used, with perfect satisfaction, this arrangement of the chamber and meter to determine X-ray output. I cannot speak highly enough of this instrument and its simplicity. It has come to be the instrument for determining dosage in the last analysis rather than the milliampere meters that are in their usual place in the circuit, and is the basis of our calculation for determining output. The meter is easily calibrated with the biologic reaction of human skin or fruit fly eggs and should be checked against 100 or more milligrams of radium every week or two.

At a meeting of this organization in Kansas City, December, 1924, I gave a paper on the use of oil-immersed Coolidge tubes operated at 200 kilovolts. This paper did not stimulate very many people to use them, largely because the X-ray companies did not encourage this deviation from their more or less standard installation. However, I have continued in my use of deep therapy tubes in oil and want to give a further report on the tube life, and call attention again to the saving of time and care with my installation.

My first tube was introduced under oil in August, 1922, and was operated for a total of 2,200 hours at from 200 to 210 K.V., corrected to sea level reading, and 5 to 8 milliamperes. I might say that at the time the tube was removed from the box it was still in running condition, but, due to the fact that the volatilization of the tungsten from the target had made a mirror of the inside of the tube, we were getting a considerable amount of "inverse." The output of this tube had diminished 44 per cent due to the cracking and pitting of the target. The tube, however, was in working condition when it was sent to the maker's laboratories. Variation in tube output from the time of installation to the end of their lives has been a constant factor in the subsequent tubes that I have used.

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1–5, 1930.

This has been proved time and again and fluctuations as great as 56 per cent have been encountered in their output. Some of these changes have been explained by cracked or roughened targets, and in one case by the raising of a blister from the face of the target which instantly diminished the output by 40 per cent. A detailed study of oil-immersed therapy tubes has been completed, and will be published elsewhere in the near future.

I do not think it expedient in this review to discuss the necessity of calculating the depth dose, nor is it necessary to show by curves or charts the increments of energy reaching various zones within the body. These data have been published repeatedly.

I do want to emphasize the importance of knowing the depth dose accurately as it accumulates, for by such information we can avoid serious and permanent damage in treating the abdominal and thoracic viscera, and the brain. The intestines will not always survive 150 per cent E.S.D., and I do not believe it advisable to give more than 130 to 140 per cent E.S.D. through the pelvis. The liver, adrenals, pancreas, and heart should never receive more than from 80 to 90 per cent E.S.D., and either lung or kidney more than 110 per cent, although small areas of lung or kidney tissue make fair recovery after being given from 4 to 10 E.S.D. The structures above the clavicles (except the brain) may safely be given 150 per cent E.S.D. However, the larynx and trachea should be shielded as much as possible.

I use the following tabulations in the calculation of all treatments by roentgen ray. Any technician or secretary can easily learn how to use them.

Table III and those following show the number of milliampere minutes required to produce an erythema with variation in tube output and also give the percentage of an E.S.D. delivered by 50, 100, 150, 200, 250, and 300 milliampere minutes.

Table VI is the form I use in calculating the depth dose as it accumulates.

The case record is self-explanatory.

In treating malignancies of the breast, chest wall, extremities, jaws, or neck, the inequalities of the surface and margins of the parts are built up with tiny bags filled with a powder that has approximately the same absorption and scattering coefficients as wa-

TABLE I.—CHART SHOWING EFFECT OF ALTITUDE ON SPARKING DISTANCES AND X-RAY OUTPUT FILTERED THROUGH 0.75 MM. COPPER AND 1.0 MM. ALUMINUM WITH A SEA LEVEL SPHERE GAP INDICATING 200,000 VOLTS

Kelley-Koett Mechanical Rectifier Intercepting 24° Peak of Arc

			Showing Increase in Milliamperes and Treatment Time to Produce an Erythema Skin Dose		
Feet above Sea Level	Actual Kilovolts	Tube Output per cent	50 cm. Distance Ma. per cent	65 cm. Distance Ma. per cent	80 cm. Distance Ma. per cent
0	200.0	100	375 = 100%	633 = 100%	960 = 100%
1,000	193.0	96	398 = 106%	677 = 107%	1023 = 106%
2,000	186.4	93	412 = 111%	695 = 110%	1058 = 110%
3,000	180.2	90	425 = 114%	713 = 113%	1085 = 113%
4,000	174.3	87	439 = 117%	738 = 116%	1125 = 117%
5,000	168.5	84	453 = 120%	762 = 120%	1163 = 121%
6,000	161.8	81	467 = 125%	786 = 124%	1204 = 125%

ter. This procedure is useful in producing a uniform dose of radiation from surface to depth. The powder used is one part hard wheat flour to two parts china whiting or pulverized white clay. This is enclosed in small bags made of oiled silk.

TABLE II.—RADIATION DECAY SCALE

Rate, 7 per cent per day

5	0.3	30	2.1	55	3.8	80	5.6	105	7.3	130	9.1
6	0.4	31	2.1	56	3.9	81	5.6	106	7.4	131	9.2
7	0.4	32	2.2	57	3.9	82	5.7	107	7.4	132	9.2
8	0.5	33	2.3	58	4.0	83	5.8	108	7.5	133	9.3
9	0.6	34	2.3	59	4.1	84	5.8	109	7.6	134	9.4
10	0.7	35	2.4	60	4.2	85	5.9	110	7.7	135	9.5
11	0.7	36	2.5	61	4.2	86	6.0	111	7.7	136	9.5
12	0.8	37	2.5	62	4.3	87	6.0	112	7.8	137	9.6
13	0.9	38	2.6	63	4.4	88	6.1	113	7.9	138	9.7
14	0.9	39	2.7	64	4.4	89	6.2	114	7.9	139	9.7
15	1.0	40	2.8	65	4.5	90	6.3	115	8.0	140	9.8
16	1.1	41	2.8	66	4.6	91	6.3	116	8.1	141	9.9
17	1.1	42	2.9	67	4.6	92	6.4	117	8.1	142	9.9
18	1.2	43	3.0	68	4.7	93	6.5	118	8.2	143	10.0
19	1.3	44	3.0	69	4.8	94	6.5	119	8.3	144	10.1
20	1.4	45	3.1	70	4.9	95	6.6	120	8.4	145	10.2
21	1.4	46	3.2	71	4.9	96	6.7	121	8.4	146	10.2
22	1.5	47	3.2	72	5.0	97	6.7	122	8.5	147	10.3
23	1.6	48	3.3	73	5.1	98	6.8	123	8.6	148	10.4
24	1.6	49	3.4	74	5.1	99	6.9	124	8.6	149	10.4
25	1.7	50	3.5	75	5.2	100	7.0	125	8.7	150	10.5
26	1.8	51	3.5	76	5.3	101	7.0	126	8.8	151	10.6
27	1.8	52	3.6	77	5.3	102	7.1	127	8.9	152	10.6
28	1.9	53	3.7	78	5.4	103	7.2	128	8.9	153	10.7
29	2.0	54	3.7	79	5.5	104	7.2	129	9.0	154	10.8

In conclusion I wish to quote a paragraph from the recommendations of the League of Nations Cancer Commission (4) as follows:

"The Sub-Commission recommends the concentration of treatment of cancer . . . in a small number of perfectly equipped institutions. It desires to draw the attention of the various authorities concerned to the disastrous results which might arise, either by encouraging, or by allowing without any control, the widespread use of radiotherapy for the treatment of cancer . . . in the hospitals or institutions which are maintained by public authorities. Without being able to express a dogmatic opinion on methods of technic, about which specialists still disagree, the Commission wishes to warn medical men and the public against the use of insufficient quantities of radium—the few needles or one or two tubes with which practitioners and small clinics sometimes attempt to treat patients. It insists on the difficulty of providing an effective and harmless deep pelvic irradiation, on the necessary strength of machines and tubes, on the great labor neces-

TABLE III.—ERYTHEMA SKIN DOSE CHART IN MILLLIAMPERES AT 200 K.V., 50 CM. DISTANCE

Kegerreis Reading 1.7 = 375 Ma. = 100 per cent E.S.D.

Keg.[2]	E.S.D. in Ma.	% E.S.D. 50 Ma.	% E.S.D. 100 Ma.	% E.S.D. 150 Ma.	% E.S.D. 200 Ma.	% E.S.D. 250 Ma.	% E.S.D. 300 Ma.
2.5	255	19.6	39.2	58.8	78.4	98.0	117.3
2.4	265	18.9	37.8	56.7	75.6	94.5	113.4
2.3	275	18.0	36.0	54.0	72.0	90.0	108.0
2.2	290	17.2	34.4	51.6	68.8	86.0	103.2
2.1	302	16.5	33.0	49.5	66.0	82.5	99.0
2.0	318	15.7	31.4	47.1	62.8	78.5	94.2
1.9	335	14.9	29.8	44.7	59.6	74.5	89.4
1.8	354	14.0	28.0	42.0	56.0	70.0	84.0
1.7	375	13.3	26.6	39.9	53.2	66.5	79.8
1.6	398	12.5	25.0	37.5	50.0	62.5	75.0
1.5	425	11.7	23.4	35.1	46.8	58.5	70.2
1.4	454	11.0	22.0	33.0	44.0	55.0	66.0
1.3	490	10.2	20.4	30.6	40.8	51.0	61.2
1.2	530	9.4	18.8	28.2	37.6	47.0	56.4
1.1	575	8.7	17.4	26.1	34.8	43.5	52.2
1.0	638	7.8	15.6	23.4	31.2	39.0	46.8

[2]"Keg." refers to the Kegerreis meter reading. Filtration = 0.75 mm. Cu + 1.0 mm. Al.

TABLE IV.—ERYTHEMA SKIN DOSE CHART IN MILLIAMPERES AT 200 K.V., 65 CM. DISTANCE

Kegerreis Reading 1.7 = 633 Ma. = 100 per cent E.S.D.

Keg.	E.S.D. in Ma.	% E.S.D. 50 Ma.	% E.S.D. 100 Ma.	% E.S.D. 150 Ma.	% E.S.D. 200 Ma.	% E.S.D. 250 Ma.	% E.S.D. 300 Ma.
2.5	430	11.6	23.2	34.8	46.5	58.1	69.7
2.4	448	11.1	22.3	33.4	44.6	55.7	66.9
2.3	468	10.6	21.2	31.8	42.5	53.1	63.7
2.2	489	10.2	20.4	30.6	40.9	51.1	61.3
2.1	512	9.7	19.5	29.2	39.0	48.7	58.5
2.0	538	9.3	18.6	27.9	37.2	46.5	55.8
1.9	567	8.8	17.6	26.4	35.2	44.0	52.8
1.8	598	8.3	16.7	25.0	33.4	41.7	50.1
1.7	633	7.9	15.8	23.7	31.6	39.5	47.4
1.6	672	7.4	14.8	22.2	29.7	37.1	44.5
1.5	717	6.9	13.9	20.8	27.9	34.8	41.8
1.4	768	6.5	13.0	19.5	26.0	32.5	39.0
1.3	827	6.0	12.1	18.1	24.2	30.2	36.3
1.2	896	5.6	11.2	16.8	22.3	27.9	33.5
1.1	978	5.1	10.1	15.2	20.4	25.5	30.5
1.0	1076	4.7	9.3	14.0	18.6	23.3	27.9

sary for efficacious treatment, and on the obligation resting on doctors not to allow radiotherapy to pass into unskilled hands."

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(2) KEGERREIS, ROY: Apparatus for Calibration of X-ray Machines. RADIOLOGY, August, 1924, III, 141.

(3) WITHERS, SANFORD: Voltage Factors Chart. Am. Jour. Roentgenol. and Rad. Ther., June, 1925, XIII, 584, 585.

(4) League of Nations Report of Health Organization: Radiological Sub-commission. Report, 1928.

TABLE V.—ERYTHEMA SKIN DOSE CHART IN MILLIAMPERES AT 200 K.V., 80 CM. DISTANCE

Kegerreis Reading 1.7 = 960 Ma. = 100 per cent E.S.D.

Keg.	E.S.D. in Ma.	% E.S.D. 50 Ma.	% E.S.D. 100 Ma.	% E.S.D. 150 Ma.	% E.S.D. 200 Ma.	% E.S.D. 250 Ma.	% E.S.D. 300 Ma.
2.5	653	7.6	15.3	22.9	30.6	38.2	45.9
2.4	680	7.2	14.5	21.7	29.0	36.3	43.5
2.3	709	7.0	14.1	21.1	28.2	35.2	42.3
2.2	742	6.7	13.4	20.1	26.9	33.6	40.3
2.1	777	6.4	12.8	19.2	25.7	32.1	38.5
2.0	816	6.1	12.2	18.3	24.5	30.6	36.7
1.9	859	5.8	11.6	17.4	23.3	29.1	34.9
1.8	907	5.5	11.0	16.5	22.0	27.5	33.0
1.7	960	5.2	10.4	15.6	20.8	26.0	31.2
1.6	1020	4.9	9.8	14.7	19.6	24.5	29.4
1.5	1088	4.5	9.1	13.6	18.2	22.7	27.3
1.4	1171	4.2	8.5	12.8	17.1	21.3	25.6
1.3	1255	3.9	7.9	11.9	15.9	19.8	23.8
1.2	1360	3.6	7.3	11.0	14.7	18.3	22.0
1.1	1484	3.3	6.7	10.1	13.5	16.8	20.2
1.0	1632	3.0	6.1	9.1	12.2	15.2	18.3

TABLE VI. RECORD OF X-RAY TREATMENT

NAME Mrs. John Doe ADDRESS _____ DISTANCE 65 cm.
FILTER 0.75 Cu

DIAGNOSIS Carcinoma cervix uteri (inoperable) REF. BY Dr. A. B. Blank

MEASUREMENTS A-P 20 cm., Trochanters 31 cm. TO HAVE 125% E.S.D. Depth Dose

Date	X-ray Ma.	Portal	Size of Portal	Keg. Read.	% Decay Previous Treat.	% Depth Dose Remaining	% Depth Dose This Treatment	% Total Depth Dose	% Surface Dose
1-22-30	300	Rt. Lat.	12 × 20	1.7	0.0	0.0	9.9	9.9	47.4
1-23-30	300	Lt. Lat.	12 × 20	1.7	0.7	9.2	9.9	19.1	47.4
1-24-30	300	Rt. Lat.	12 × 20	1.6	1.3	17.8	9.3	27.1	44.5
1-25-30	300	Lt. Lat.	12 × 20	1.7	1.8	25.3	9.9	35.2	47.4
1-26-30					2.4	32.8		32.8	
1-27-30	200	Anterior	20 × 20	1.8	2.3	30.5	14.3	44.8	33.4
1-28-30	200	Posterior	20 × 20	1.8	3.1	41.7	14.3	56.0	33.4
1-29-30					3.9	52.1		52.1	
1-30-30	200	Anterior	20 × 20	1.7	3.6	48.5	13.6	62.1	31.6
1-31-30	200	Posterior	20 × 20	1.7	4.3	57.8	13.6	71.4	31.6
2- 1-30	200	Anterior	20 × 20	1.6	4.9	66.5	12.8	79.3	29.7
2- 2-30					5.5	73.8		73.8	
2- 3-30	200	Posterior	20 × 20	1.7	5.1	68.7	13.6	82.3	31.6
2- 4-30	200	Anterior	20 × 20	1.7	5.7	76.6	13.6	90.2	31.6
2- 5-30					6.3	83.9		83.9	
2- 6-30					5.8	78.1		78.1	
2- 7-30	200	Perineal	12 × 12	1.7	5.4	72.7	19.0	91.7	31.6
2- 8-30	200	Perineal	12 × 12	1.7	6.3	85.4	19.0	104.4	31.6
2- 9-30	200	Perineal	12 × 12	1.7	7.2	97.2	19.0	116.2	31.6
2-10-30	250	Posterior	20 × 20	1.7	8.1	108.1	17.0	125.1	39.5

CLINICAL AND EXPERIMENTAL LEAD POISONING: SOME ROENTGENOLOGIC AND ANATOMIC CHANGES IN GROWING BONES[1]

By JOHN CAFFEY, M.D., NEW YORK CITY

From the Babies' Hospital of New York City, and the Department of Diseases of Children, College of Physicians and Surgeons, Columbia University

THE purpose of this report[2] is to present and correlate some roentgenologic and anatomic changes occurring in the growing skeleton during both clinical and experimental lead poisoning, and to consider the roentgenologic sequelæ in the bones of two children who recovered from chronic lead poisoning.

The selective deposition of lead in the skeleton has been clearly shown in the extensive studies of Minot and Aub (1). Their demonstration chemically of lead storage in bone first suggested to me that retention of lead in bones might also be shown roentgenologically. Aub and his co-workers (2) concluded that a high concentration of lead occurs in the solid portion of the bone, whereas the marrow contains only traces of lead. They did not mention the ends of the diaphyses as special sites of lead deposit. We had anticipated that the roentgenologic findings in lead poisoning might be a generalized increase in bone density. Therefore, the pronounced changes limited to the ends of the shafts first seen in Case 1, October, 1929, were unexpected.

Case 1. M. K., 18 months of age, was admitted to the Babies' Hospital on Oct. 21, 1929, from the Out-patient Department, with the diagnosis of chronic poisoning by lead. The familial, natal, and developmental histories were normal. Three months previously the child had begun to vomit. The vomiting had increased in both frequency and severity until, during the few weeks just past, emesis had occurred after all attempts to take food or even water. About four months previous to admission there had been a decided change in the child's disposition and activity. This previously normal child had become hyperirritable, crying most of the day and "shaking continually and waving her arms frantically in the air." The infant had begun to walk about the fourteenth month, and the mother thought that she had walked as well as most children of this age, until the last two months before admission to the hospital, when she "fell down frequently" and finally stopped walking (one month before). Attempts to encourage her to begin walking again were unsuccessful. The child "staggered badly." No convulsive seizures had been observed. She was supposed to have gained normally during this time. Two and one-half months before admission, pallor was first noted, which had gradually increased up to the day of admission. The mother offered the information that at the fourteenth month, the approximate date when she started to walk, the infant was first seen to chew on the painted surfaces of woodwork about the household —window-cases, doors, crib, beds, and chairs. This perversion of appetite had continued throughout the last four months, and during this time several "large areas of paint had been chewed off" these surfaces.

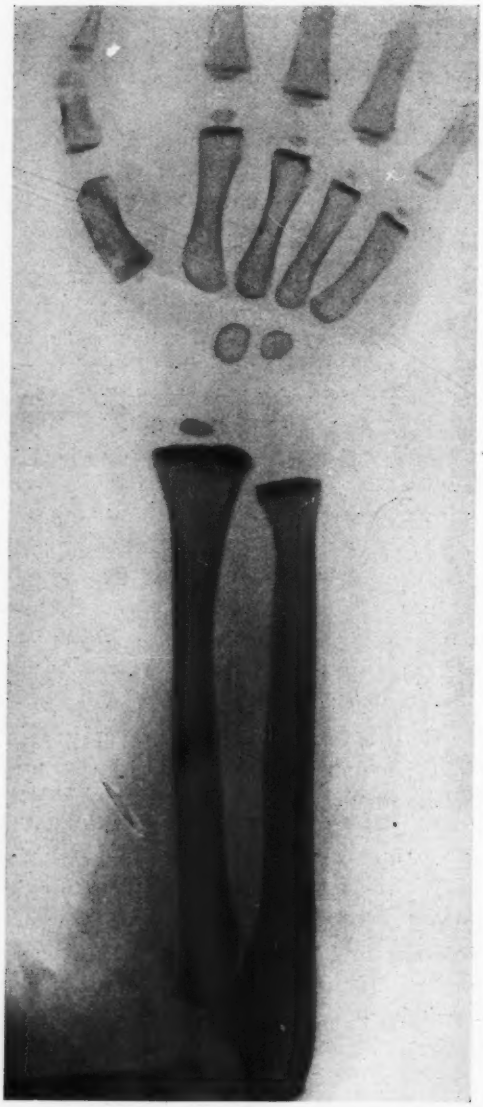
PHYSICAL EXAMINATION

Measurements: head 18½ inches, length 30¼ inches.

General.—Nutrition and development appear to be normal except for a moderate generalized pallor. The child cries and whines throughout the examination. She is exceedingly hyperactive, excessive movements be-

[1]Read before the New York Roentgen Ray Society, April 20, 1931.

[2]This study was assisted by a grant from the Chemical Foundation of New York City.



Figs. 1-*A* (Case 1), 1-*B* (Case 2), and 1-*C* (Case 3). Upper extremities in Cases 1, 2, and 3. Bands of increased density at the distal ends of the radii, ulnæ, and metacarpals, with the exception of the distal first metacarpals. Note variation in the width (longitudinal) of the different patients and in different bones in the same patient.

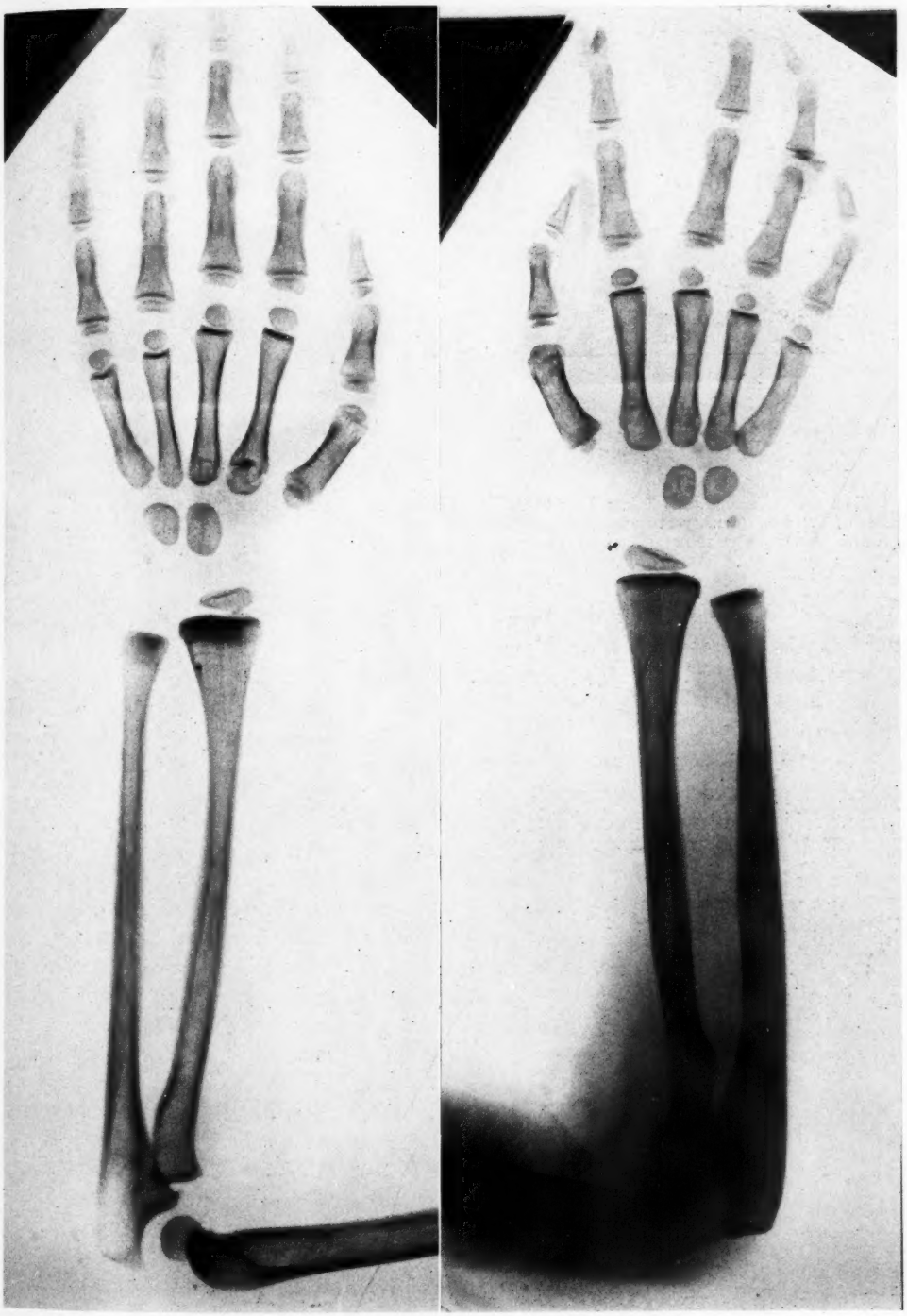
ing limited to the extremities, which are in continuous, stereotyped, short, jerky motion. A particularly noticeable movement is a repeated, purposeless, rapid, rotatory movement of the forearms. The patient can stand erect unassisted for only a few seconds. When forced to walk, she takes a few steps only, the gait being decidedly ataxic. There is marked ataxia of the upper extremities when she attempts to grasp objects. No discoloration of the gingival mucous membranes suggesting "lead lines" is seen. Heart and lungs are normal. Spleen and liver are not enlarged. All the extremities are hypertonic with exaggerated deep tendon reflexes in both upper and lower. There is no evidence of ankle or wrist drop. Palpation of the nerve trunks is not entirely satisfactory, but no tenderness or enlargement of these can be made out.

Frequently during and since the examination the child has been seen to assume the knee-chest position, with the face buried in the bed clothes. There is no evidence of photophobia, however, when bright light is brought near the eyes. The skin of the hands and feet shows a reddish discoloration and questionable subcutaneous edema. The impression at this time is that the child is suffering from a meningo-encephalitis due to lead poisoning which has been caused by the ingestion of lead over a period of several months. The tendency to assume the knee-chest position, the reddish discoloration of the hands and feet, and the hyperirritability are all suggestive of acrodynia, which will be considered until lead poisoning can be investigated chemically.

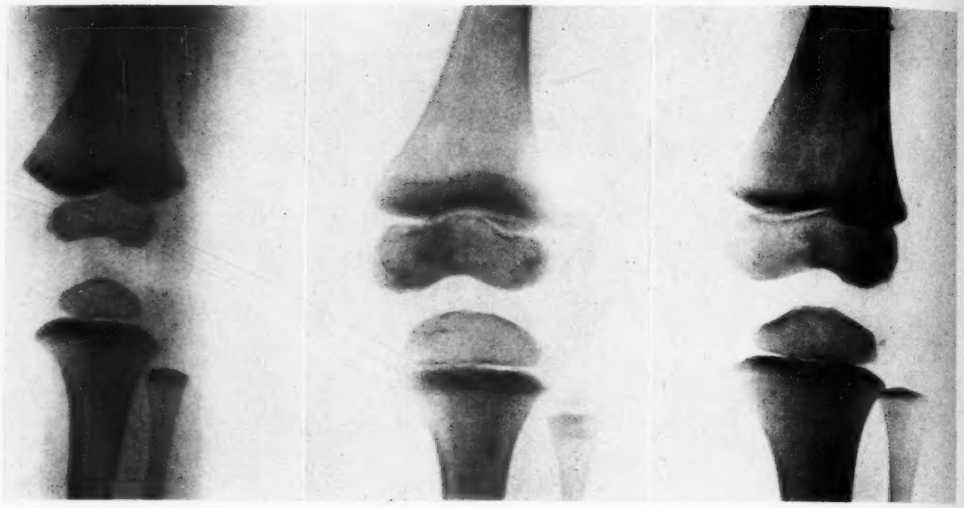
LABORATORY FINDINGS

Hematology.—Hemoglobin, 70 per cent; erythrocytes, 5,900,000; leukocytes, 13,000; polymorphonuclears, 49 per cent; lymphocytes, 51 per cent. Considerable "stippling" of the basophilic erythrocytes is present, averaging 3 or 4 "stippled" cells to each high-power field.

Urine Examination. — Reaction, acid; specific gravity, 1.018; albumin, trace; reducing substances, negative; microscopic,



Figs. 1-*B* and 1-*C*. See caption under Figure 1-*A*.



Figs. 2-*A* (Case 1), 2-*B* (Case 2), and 2-*C* (Case 3). Lower extremities in Cases 1, 2, and 3. Lead bands of increased density at the ends of the bones at the knee joints. Note width of femoral lesions and variation in involvement in different cases.

negative. Pooled specimens of urine collected October 28 to November 5 yielded large amounts of lead in a qualitative test.[3]

Feces.—Chemical examination for lead was negative.

Blood Chemistry.—Chlorides 475 mg. per 100 c.c.; blood sugar, 113 mg. per 100 c.c.; serum calcium, 12.4 mg. per 100 c.c.; serum inorganic phosphorus, 4.2 mg. per 100 cubic centimeters.

Cerebrospinal Fluid.—Pressure, negative; clear; cells, 16 per cubic millimeter; globulin 1+; sugar 2+; smear and culture, negative bacteriologically.

Blood Serology.—Kahn test, standard and presumptive procedures, negative.

ROENTGENOLOGIC EXAMINATION OF THE BONES (OCTOBER 25, 1929)

Stereoscopic Examination of Skull.—No abnormalities were seen.

Long Bones: Upper Extremities (Fig. 1-*A*).—Bands of increased density are seen extending transversely across the proximal ends of the shafts of humeri, distal ends of radii and ulnæ, distal ends of all metacarpals excepting the first, and in the proximal ends of the phalanges. Similar changes are not seen on the distal ends of the humeri, nor on the proximal ends of the ulnæ. On closer inspection, a very narrow line of increased density is made out across the proximal ends of both radii. Two ossification centers are present in each carpus, which show moderate increase in density of their margins. The cortices of the long bones show no definite changes in density. No sub-periosteal changes are seen. *Lower extremities* (Fig. 2-*A*): transverse bands of density similar to those seen in the upper extremities are present at the ends of the following bones: both ends of the femora, tibiæ, and fibulæ. The ossification center of the epiphysial cartilage of the distal femora, both ends of the tibiæ, and distal ends of the fibulæ show a definite increase in the density of narrow marginal zones. In the lower extremities, as in the upper, the bands of increased density across the ends of the bones vary consider-

[3]The writer is indebted to Dr. R. C. Sullivan, for the several chemical analyses in this study, and to Dr. Martha Wollstein, in whose laboratory the anatomic preparations were studied.

ably in their longitudinal width in different bones, and also even at the two ends of the same bone. This variation is apparent in the following measurements of the width of these bands of increased density and in the semidiagrammatic sketches in Figure 3-*A*.

Upper Extremities:

Proximal humeri	4 mm.
Distal radii	2 mm.
Distal ulnæ	2 mm.
Proximal radii	0.5 mm.
Proximal metacarpals	0.5 mm.
Proximal basal phalanges	0.5 mm.
Proximal ulnæ	no change
Distal humeri	no change

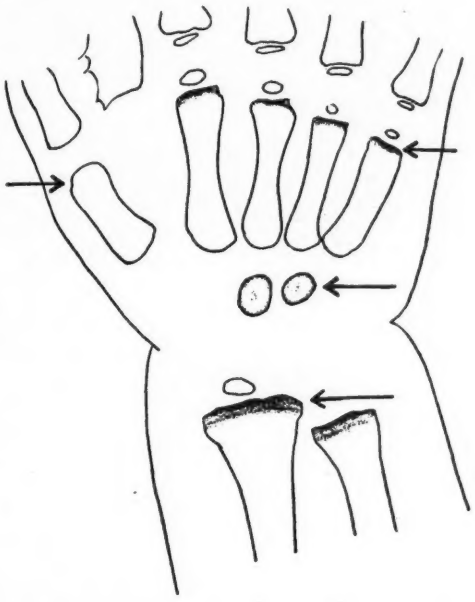
Lower Extremities:

Proximal femora	2 mm.
Distal femora	6 mm.
Proximal tibiæ	3 mm.
Distal tibiæ	2.5 mm.
Proximal fibulæ	3 mm.
Distal fibulæ	2.5 mm.

More detailed inspection of these bones shows that the bands of increased density at the ends of the tibiæ, fibulæ, and distal radii are made up of narrower bands of increased density instead of single uniform zones. The bands on the distal femora (the widest of any of the changes) also appear to be made up of a number of narrower, transverse lines of increased density in a lamellar arrangement, rather than a single wider zone of increased density. The shaftward margins of the bands of increased density are hazy and poorly defined (gradually fading out into the shaft) at the distal and proximal ends of the femora and proximal end of the radii.

COURSE

The patient remained in the hospital for two months. Shortly after admission, she was seen to chew on the furniture in the hospital. This was prevented only after heavy taping of her crib, and watchful nursing care. Irradiated ergosterol (vigantol) was given in the hope of fixing the lead in the skeleton temporarily and to prevent further involvement of the central nervous system. Clinical improvement, however, was very slow. At the end of the two



Figs. 3-*A* (Case 1), 3-*B* (Case 1), and 3-*C* (Case 1). Semidiagrammatic sketches showing the variations in width of the lead bands of increased density in the different bones and in different ends of the same bone. Lesions at the end of the femora are the widest.

months she was able to walk alone, but both upper and lower extremities were decidedly ataxic. The hyperirritability and overactivity had subsided partially, but from these standpoints the patient was still definitely abnormal. Basophilic stippling of the erythrocytes was confirmed in several blood examinations. The amounts of stippling had greatly decreased, although an occasional "stippled" cell was still present as late as the fiftieth day after admission. Concentration of inorganic calcium in

the blood serum rose to 14.6 mg. per 100 c.c. during irradiated ergosterol treatment. Following her first examination, the patient was kept under observation for thirteen months. Despite precautions of the mother

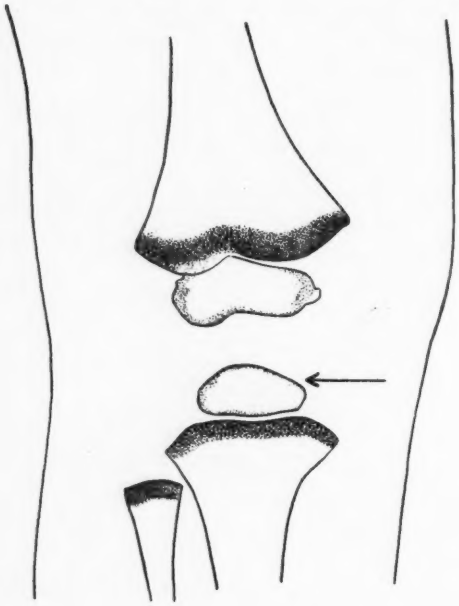


Fig. 3-*B*. See caption under Figure 3-*A*.

at home, the child was seen occasionally to chew lead painted articles. "Stippling" of the erythrocytes had completely disappeared 6½ months after admission to the hospital and there was a gradual clinical improvement until, at the end of the eighteenth month, she appeared to be free of her previous symptoms.

FOLLOW-UP ROENTGENOLOGIC EXAMINATIONS

These were made 1 month, 6 months, and 13 months after she first came under observation and the findings are shown in Figures 4-*A, B, C, D* and 5-*A, B, C, D* and in the explanatory diagrammatic sketches (Figs. 6 and 7). It is noteworthy that one month after admission and after the source

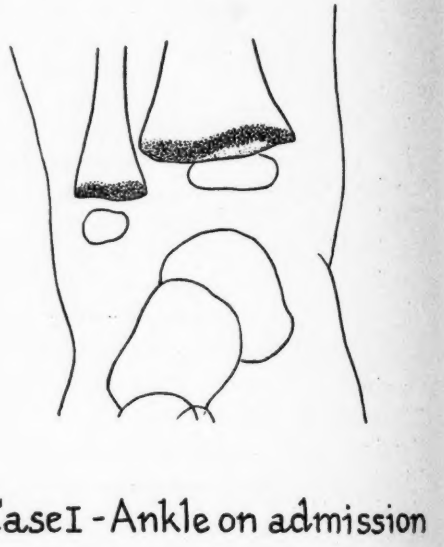
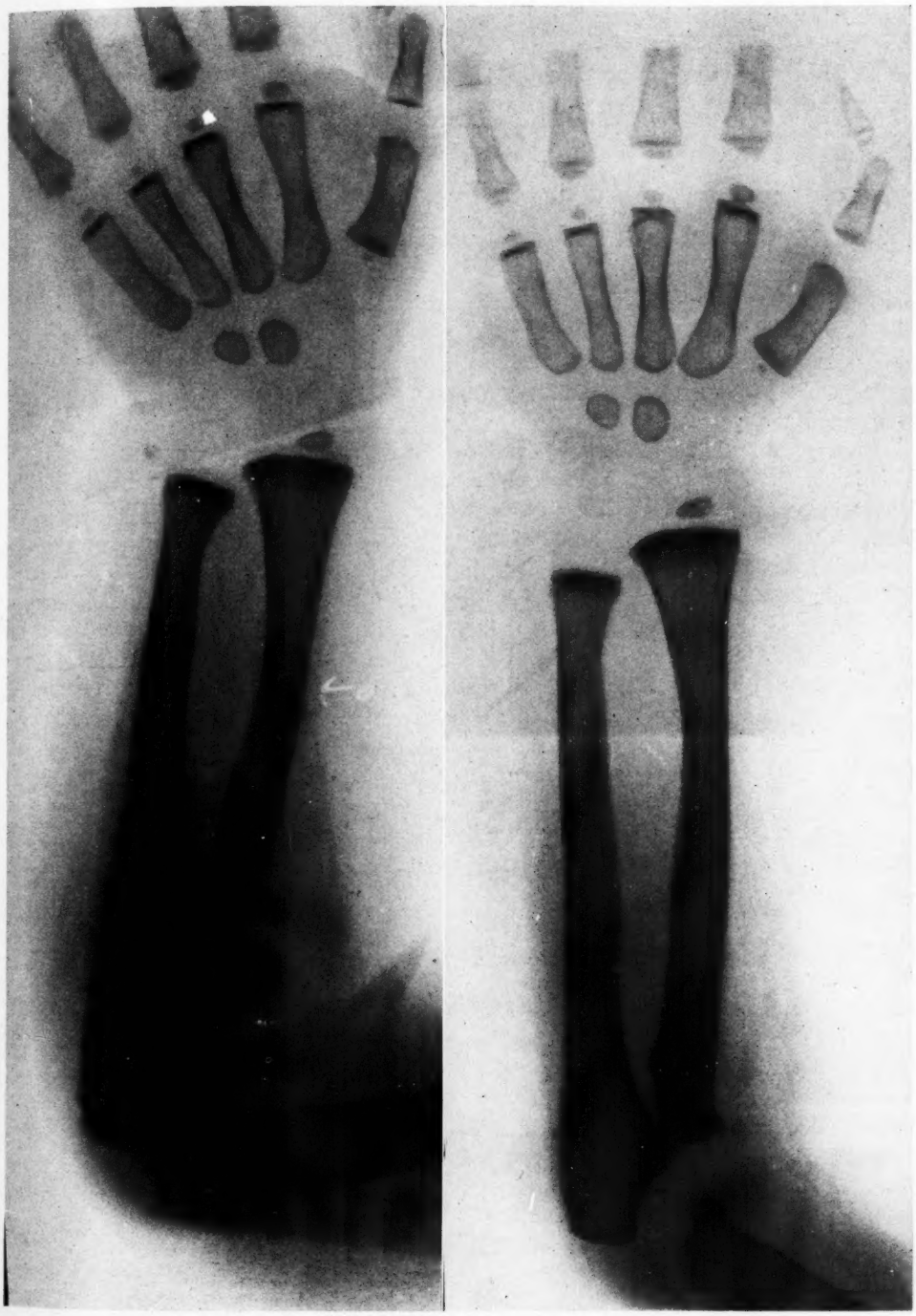


Fig. 3-*C*. See caption under Figure 3-*A*.

of lead had been eliminated, the density of the bands at the ends of the long bones had increased rather than decreased. The margins of the carpal bones and the ossification centers of the epiphyses also showed this increase in density. We considered the Vitamin D therapy,[4] which had been instituted, the possible cause of this increase in density despite the fact that ingestion of lead had been stopped. Another possible explanation is that, following stoppage of absorption of lead from the gastro-intestinal tract, lead continued to be deposited in the skeleton, as observed by Minot and Aub (1).

At the sixth month of observation, the bands of increased density at the ends of

[4]Vitamin D therapy consisted of ingestion of an average dose of 12 drops daily of vigantol over a period of 20 days. Irradiated ergosterol in such dosage in other non-rachitic children of this age has not in our experience caused marked changes and hypercalcification of the ends of the bones. It is possible that in lead poisoning irradiated ergosterol therapy has more marked effect on bone density than in individuals who are not suffering from lead poisoning.



Figs. 4-*A* (on admission), 4-*B* (first month). Upper extremities in Case 1 showing the roentgenologic sequelæ at 1 month, 6 months, and 13 months (see Figs. 4-*C* and 4-*D*) after the first examination. Note particularly the changes in the carpal bones at the thirteenth month and the series of "transverse lines" which have persisted in the shaft of the distal radius

the bones are seen to be fading out and are being replaced by series of narrow "transverse lines" of increased density at various levels throughout the terminal portion of the diaphysis. The numbers of these "transverse lines," and the longitudinal width of the zone of shaft involved by them, vary from a wide zone 2 cm. in width, with at least six transverse lines in the distal portion of the femora, to a zone of less than 2 mm. with but two transverse lines in the distal radii. Detailed examination of these films with a hand lens shows a definite exaggeration of trabecular shadows and a distortion of the pattern as shown in the roentgenograms and diagrammatic figures. This is worthy of comment, in view of the microscopic changes in Case 3. The carpal bones and the ossification centers of the epiphysial cartilages show increases in both width and density of their margins, despite fading of similar lesions at the ends of the long bones. After 13 months, the ends of the long bones show a continuation of the fading seen at the sixth month, and also "transverse lines" are less well seen. The fading "transverse lines" are deeper in the shaft than on previous examination. Trabeculation approaches normal, but still shows changes seen in the diagrammatic sketches. The carpal bones and ossification centers of the epiphyses have grown considerably during the last 7 months. These now show a normal peripheral margin, but within this normal outer margin there is an inner ring of increased density. This follows the normal contour of the bones. Superimposition of the film of 13 months earlier, made during the phase of active lead poisoning, shows that this inner ring corresponds almost exactly with what was previously the peripheral margin of the bone.

Case 2. G. G., aged 2 years, was admitted to the Babies' Hospital Nov. 11, 1929, with the complaint of failure to gain during the last year. Anorexia and vomiting had been present from early infancy. The mother thought the child had been "cross-eyed" for approximately three months.

ADMISSION PHYSICAL EXAMINATION

Positive Findings.—Moderate malnutrition, moderate generalized pallor, right internal strabismus, and exaggeration of the deep tendon reflexes of both upper and lower extremities. There were no findings to suggest the over-activity and hyperirritability seen in Case 1. Rather, the child was apathetic, resting quietly in bed when not disturbed. There was no disturbance of gait. There was no evidence of a "lead line" on the gingival mucous membranes and no clinical signs of peripheral neuritis.

LABORATORY FINDINGS

Hematology.—Hemoglobin, 90 per cent; red blood cells, 4,000,000; white blood cells, 9,000; polymorphonuclears, 55 per cent; lymphocytes, 35 per cent; eosinophils, 7 per cent; unclassified, 3 per cent. Occasional basophilic stippling of erythrocytes was present, but to a considerably less degree than in Case 1.

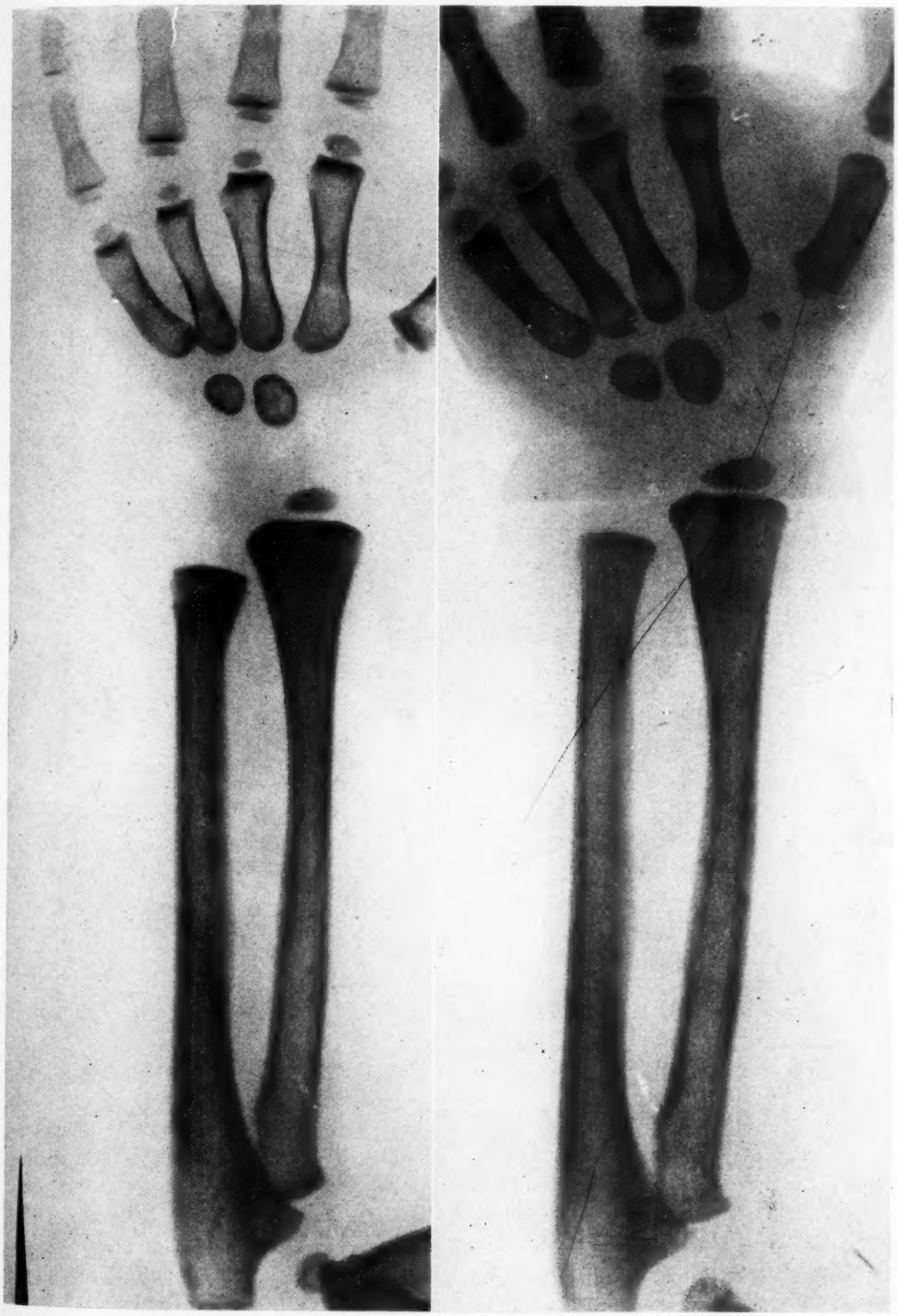
Urine.—Negative except for acetone during the first 48 hours of hospital residence. Lead was demonstrated qualitatively in pooled specimens of urine collected during the same time.

Feces.—Positive for lead qualitatively, otherwise normal.

Cerebrospinal Fluid.—Normal.

Serology.—Blood Kahn test, standard and presumptive tests were negative.

Following the discovery of basophilic stippling of the erythrocytes, further questioning revealed that the child had had an abnormal appetite (as long as the mother could remember). The patient had been seen chewing on painted woodwork in the house, and on the furniture. She was also known to have eaten "rubbish, garbage, and flies." These facts were confirmed later in the hospital when the nurses noted that

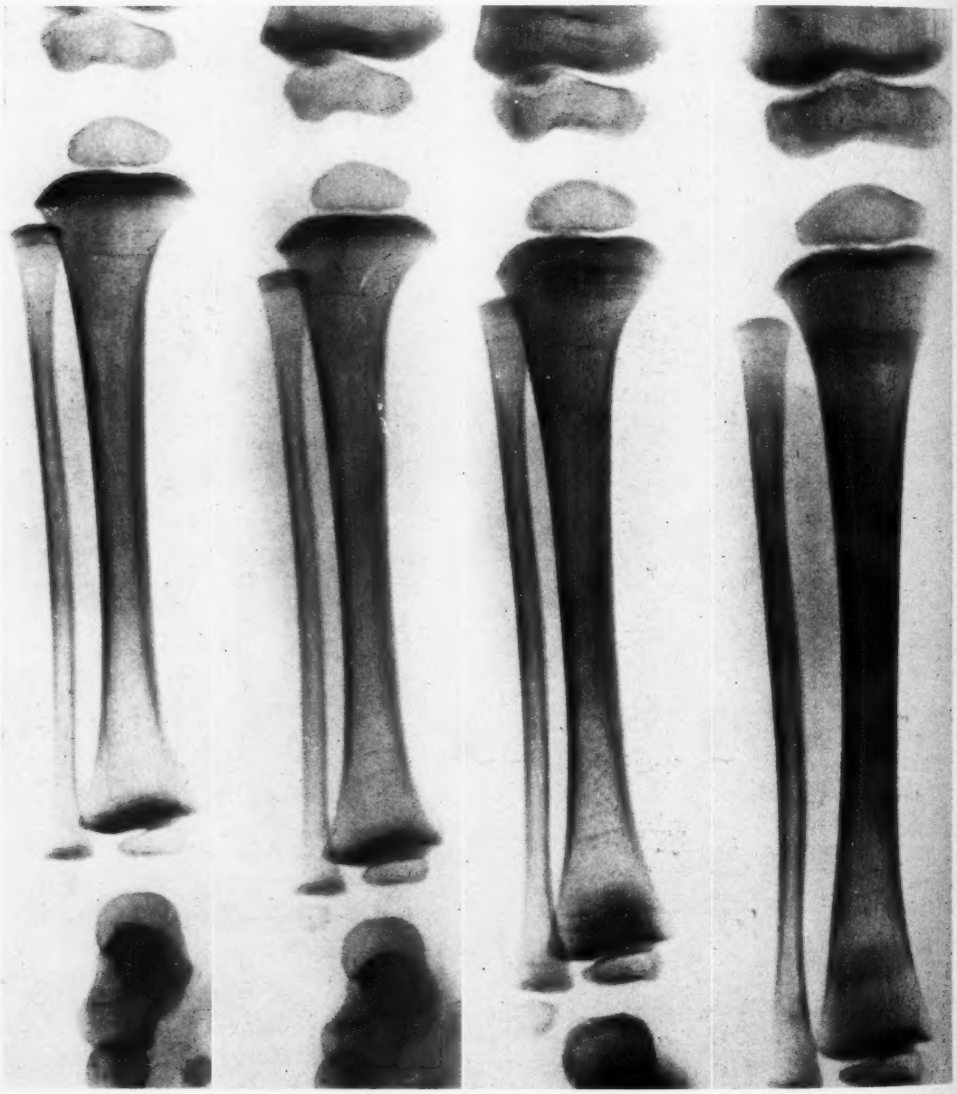


Figs. 4-*C* (sixth month) and 4-*D* (thirteenth month). See caption under Figs. 4-*A* and 4-*B*.

"she attempts to eat everything she can get her hands on—string, paper, soap, etc."

ROENTGENOLOGIC EXAMINATION OF THE LONG BONES (NOV. 12, 1929)

Transverse bands of increased density (Figs. 1-*B* and 2-*B*) are present on the ends of the shafts of the long bones of both upper and lower extremities. As in Case 1, there is considerable variation in the longitudinal width of these bands in the different bones. The widest bands are present at the distal femora, proximal humeri, and both ends of the tibiæ and fibulæ. The narrow-



Figs. 5-*A* (on admission), 5-*B* (first month). 5-*C* (sixth month), and 5-*D* (thirteenth month). Roentgenologic sequelæ in the lower extremities in Case 1 at 1 month, 6 months, and 13 months after the first observation. Note the changes in the ossification centers of the epiphysial cartilages at the distal ends of the femora and proximal ends of the tibiæ. Multiple "transverse lines" of increased density are apparent deep in the shafts in the later examinations.

est bands are seen at the radii and ulnæ proximally. No changes are seen in the margins of the carpal bones nor the ossification centers of the epiphysial cartilages.

In comparison with Case 1, the roentgenologic lesions are wider throughout; that is, they involve wider longitudinal zones of the shaft in corresponding bones, but the density of the corresponding lesions is not so marked. In addition, the shaftward borders of the lesions are less sharply delimited in Case 2, fading out gradually into the shaft. The bands of increased density in Case 2 are also not so uniform in the degree of density in different parts of the same lesion. Several "transverse lines" of increased density can be seen making up the single lesion at the ends of the bones. In these zones of increased density at the ends of the bones, one can also make out exaggeration of the longitudinal trabecular pattern in the zones contiguous to the narrow "transverse lines." Following are measurements of the longitudinal width of the bands of increased density at the ends of the diaphyses.

Upper Extremities:	
Proximal humeri	6 mm.
Proximal radii	1 mm.
Distal radii	4.5 mm.
Distal ulnæ	4.5 mm.
Distal metacarpals	1 mm.
Lower Extremities:	
Proximal femora	4 mm.
Distal femora	9 mm.
Proximal tibiæ	6 mm.
Distal tibiæ	5 mm.
Proximal fibulæ	6 mm.

Follow-up roentgen observations were made 4 and 11 months after the initial examination. The films at these times show a gradual fading out of the lesions previously present, with a persistence of a series of "transverse lines" across the shafts at the levels corresponding with the sites of the previous bands of increased density. The new bone, which had grown out beyond the site of the previous lesions during the 4- and 11-month intervals, was more dense than normal for this age, although not so dense as the ends of the shafts when first seen. This suggests that probably the child has continued to eat lead despite the mother's efforts to control her, or that the bones are being affected still from lead drained from other tissues of storage. In the carpal bones and ossification centers of the epiphysial cartilages, no sequelæ have developed comparable to those seen in Case 1 at 6 and 13 months.

Clinically there were no notable features during the follow-up period of 11 months.

Case 3. B. Y., aged 3 years, was admitted to the Babies' Hospital, Feb. 8, 1930, with a history of constipation for 3 weeks and moderate vomiting for 10 days. Twelve hours before admission, generalized convulsions began which had increased in frequency and severity. Vomiting had also occurred several times during the previous 12 hours. During the last 4 months the child has been found frequently "gnawing on beds and chairs."

PHYSICAL EXAMINATION

The patient is in deep coma from which she cannot be aroused. Frequent generalized clonic convulsions occur. Between convulsive seizures, the muscles are flaccid. Deep tendon reflexes are exaggerated. Sustained bilateral ankle clonus is present on both sides. No "lead line" is present on the gingival mucous membranes. No evidence of foot drop or wrist drop. No other abnormalities are present except a moderate generalized pallor.

LABORATORY FINDINGS

Hematology.—Hemoglobin, 60 per cent; erythrocytes, 4,600,000; leukocytes, 25,000; polymorphonuclears, 83 per cent; lymphocytes, 13 per cent; monocytes, 4 per cent.

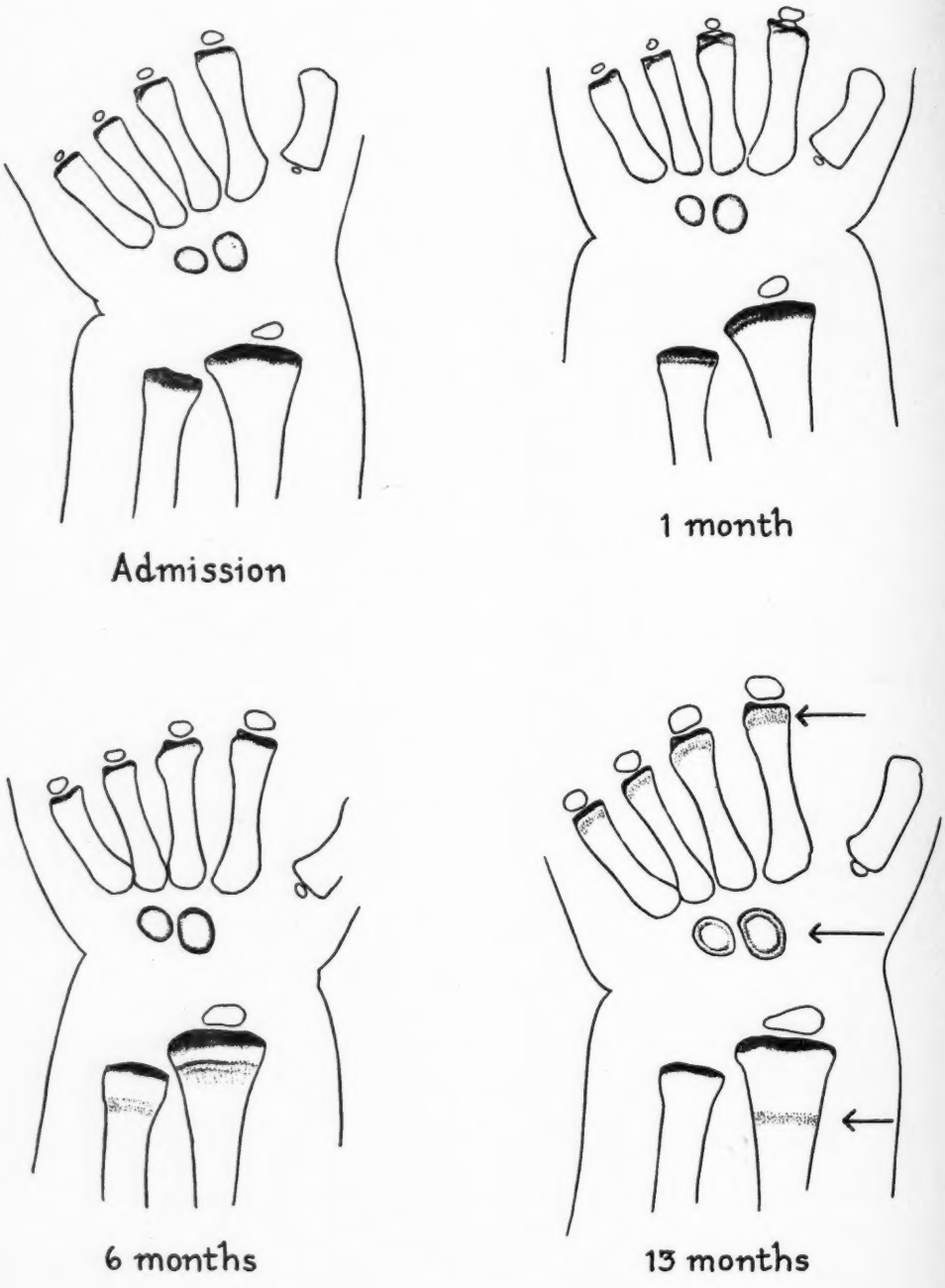


Fig. 6. Sequelæ of lead poisoning in hand and wrist.

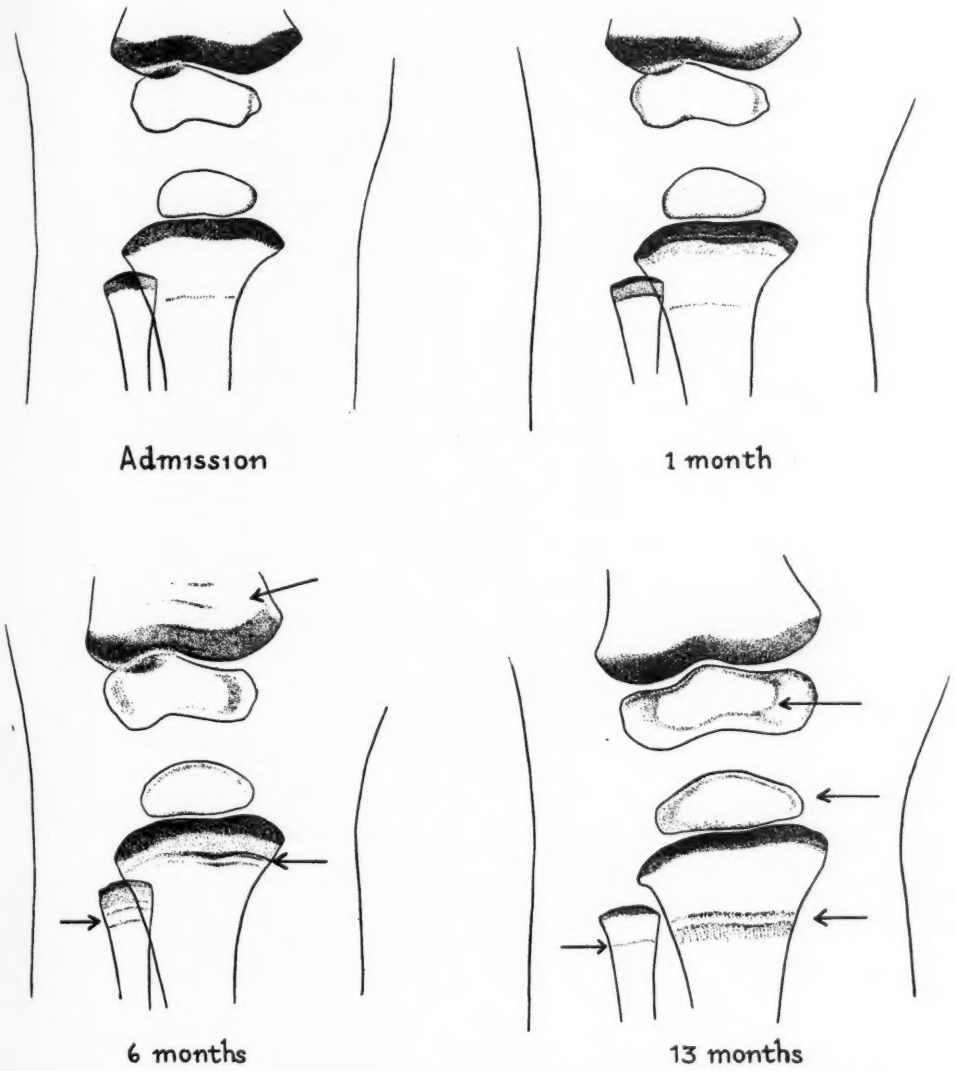
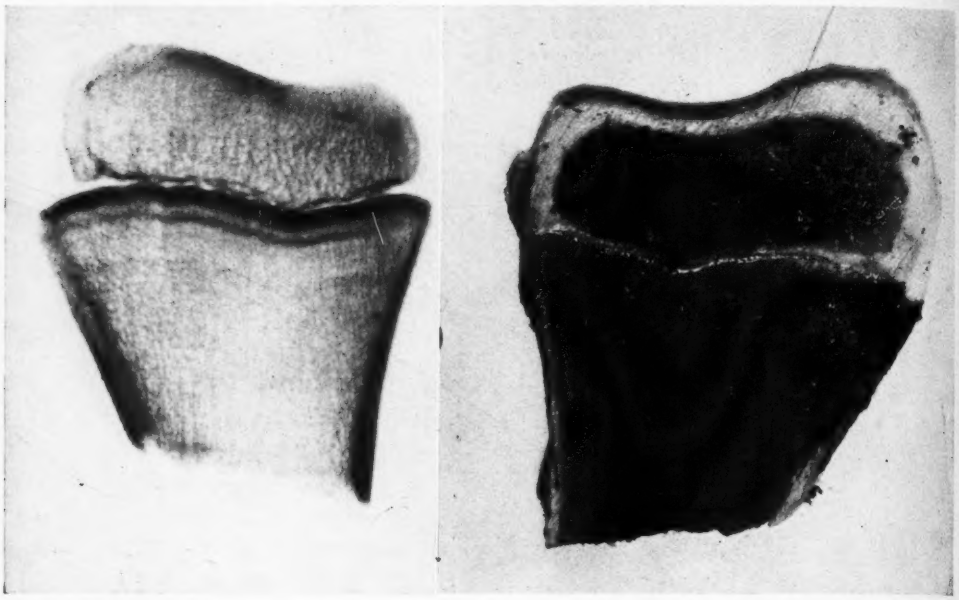


Fig. 7. Sequelæ of lead poisoning at knee and ankle.



Figs. 8-*A*, 8-*B*, 8-*C*, and 8-*D*. Anatomic findings in the distal end of the right femur in Case 3.

Fig. 8-*A* (*left*). Note in roentgenologic specimen a double line of increased density at the end of the bone.

Fig. 8-*B* (*right*). The gross specimen, showing a narrow zone of compact osseous tissue adjacent to the epiphysial cartilage.

Nine nucleated red blood cells per 100 leukocytes are present. Four erythrocytes with basophilic stippling are present for every 100 leukocytes counted.

Cerebrospinal Fluid. — Pressure, increased; showed clear; cells, 70 per cubic millimeter; lymphocytes, 90 per cent; globulin, 2+; sugar 4+. Smear and culture, no bacteria present.

Urine.—Postmortem specimen from bladder: Reaction, acid; protein, 4+; reducing substances, 4+; acetone, negative; microscopic, many leukocytes seen.

COURSE

Convulsions and coma persisted despite emergency treatment. The patient died 5 hours after admission to the hospital.

ROENTGEN EXAMINATION OF THE LONG BONES (POSTMORTEM)

The long bones of the extremities (Figs. 1-*C* and 2-*C*) show bands of increased density at the distal ends of the shafts of the radii, ulnæ, and femora, both ends of the tibiæ and fibulæ, and metacarpals. Similar changes are not present at the proximal ends of the radii, ulnæ, and distal ends of the humeri. The bands of increased density in this case are narrower throughout than those seen in Case 1 and Case 2, although the density of these narrow bands is approximately equal to those seen in previous cases. Also fewer "transverse lines" are seen in this case, deeper in the diaphyses. None is present in the upper extremities, while suggestive "transverse lines" are present on the diaphysial side of the bands of increased density on the distal ends of the femora and faint "transverse lines" on the proximal end of the right tibia. Following are measurements of the longitudinal width of the bands of increased density on the ends of the diaphyses:

Upper Extremities:

Distal radii	1.5 mm.
Distal ulnæ	1.5 mm.
Proximal ulnæ	0
Proximal radii	0
Distal humeri	0
Distal metacarpals.....1st, 0, 2d, 3d, 4th, 5th	0.5 mm.

Lower Extremities:

Distal femora	4 mm.
Proximal tibiæ	2 mm.
Proximal fibulæ	2 mm.
Distal tibiæ	1.5 mm.
Distal fibulæ	1 mm.

NECROPSY FINDINGS

Anatomical.—Cerebral edema, pulmonary edema and congestion, chronic fibrinous pleurisy, fatty liver, fatty degeneration of the kidneys, and gastric erosion.

Chemical Analysis.—Large amounts of lead were present in the liver, intestines, and to a less extent in the kidneys. Lead could not be demonstrated in the spleen. Control examination of corresponding tissues from another patient 18 months of age was negative for lead.

Examination of Bones. (Permission was granted for removal of the terminal portion of the right femur.): *Macroscopic Examination.*—This bone was of normal appearance on removal but the longitudinal section macroscopically showed a narrow zone across the end of the shaft and contiguous to the epiphysial cartilage which appeared denser and to contain less marrow than the remainder of the specimen (Fig. 8-*B*). This zone was in the approximate position of the band of increased density seen in the roentgenogram of the distal end of the right femur. X-rays were taken of the specimen of this bone (Fig. 8-*A*). A narrow band of increased density is seen on the end of the shaft and contiguous to the epiphysial cartilage. This band measures 2 mm. in width. In addition, 1 mm. shaftward there is a second narrow band of increased density 1 mm. in width. One can make out clearly in this roentgenogram of the specimen that the increase in density at the end of the shaft is made up of a fusion of exaggerated trabecular shadows which are seen to run through both the first and second transverse zones of increased density present. In addition, one can make out with a hand lens several finer lines of increased density shaftward in the bone which were not visible in the postmortem X-ray of the femur taken before the bone was removed from the soft tissues of the leg.

Microscopic Examination.—Lower power, magnification × 15 (Fig. 8-*C*)/shows a definite change in the trabecular pattern of the juxta-epiphysial portion of the shaft. This consists of a narrow zone showing a marked increase in the number of trabeculæ. These are small in caliber but are very closely packed together resulting in a marked decrease in the volume of the marrow spaces, in this zone of the bone bordering on the epiphysial cartilage. This increase in the number and concentration of trabeculæ is located in the exact portion of the bone which showed the increased opacity to the X-ray. No changes are seen in the neighboring cartilage. Trabeculation of the margins of the ossification centers appears normal and does not show the increase and concentration of trabeculation seen on the end of the shaft. It is noteworthy that there is no trabecular change seen to explain the second band of increased density which shows clearly in the roentgenogram of the cut section of the bone (Fig. 8-*A*). This is probably due to the fact that the change is sufficiently marked to be visualized in a roentgenogram, which is the summation of all the changes in density through the entire diameter of the bone, but is not sufficiently marked to show in a thin microscopic section. A higher magnification, × 275 (Fig. 8-*D*), shows in more detail the

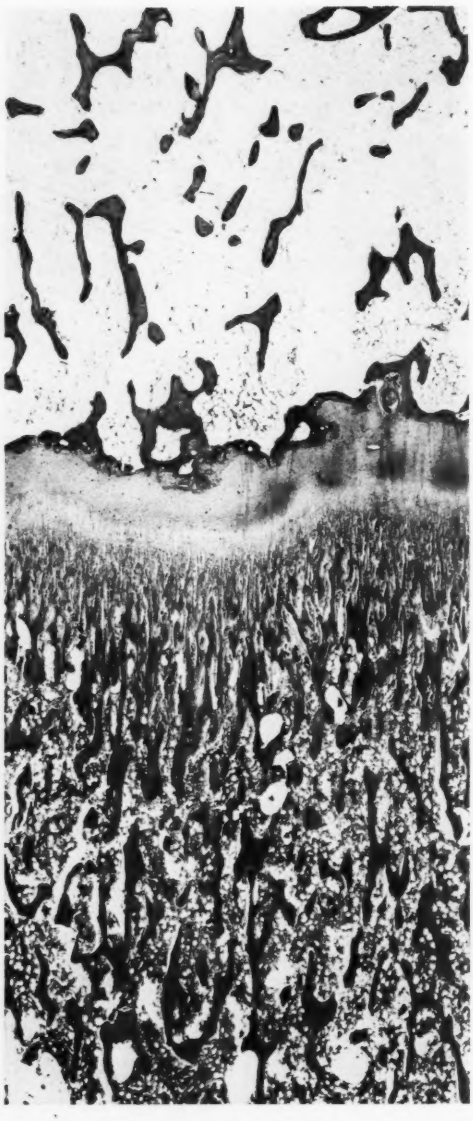


Fig. 8-*C*. This low power magnification shows hyperplasia and crowding together of trabeculæ in the sub-epiphysial zone adjacent to the proliferating cartilage. Similar changes are not present at the borders of the ossification center of the epiphysial cartilage. (Magnification × 15.) (See 8-*A* and 8-*B*.)

closeness of the mesh of trabeculation, and particularly the obliteration of the marrow spaces in the juxta-epiphysial zone of the shaft.

Chemical Examination.—The distal portion of the right femur from which the microscopic section described above was taken was examined chemically for lead. An attempt was made to obtain a segment of bone from the end of the shaft which corresponded as nearly as possible with the band of increased density seen in the roentgenograms and with the zone showing hyperplasia of trabeculation in the microscopic section. It was not possible to do this exactly because the limits shaftward of these lesions were not sharply defined. The segment obtained undoubtedly contained considerable normal appearing bone beyond both the roentgenologic and microscopic lesions.[5]

1. The horizontal disc of bone obtained from the distal end of the shaft of femur and corresponding approximately to the roentgenologic and microscopic lesions contained 0.7 mg. of lead per gram of dry bone examined.

2. Remainder of the shaft of the right femur contained 0.19 mg. of lead per gram of bone examined.

3. Control examination of similar specimens of right femur of a patient 18 months of age, who died with congenital malformation of the heart and who had no clinical evidence of lead poisoning, was negative for lead when examined with the same technic.

EXPERIMENTAL LEAD POISONING

EXPERIMENT I

Purpose.—To determine the effects of ingestion of lead on the skeletons of growing animals.

Procedure.—Four young dogs, litter mates, approximately 6 weeks of age, were used. Animals 1 and 2 were irregularly fed lead acetate (10 per cent) by a dropper in varying amounts. Quantitative studies were not made. Animals 3 and 4 were kept in the same pens, under identical conditions

[5]For this reason, the actual lead content of the end of the bone was probably greater than the analyses indicate.

with Animals 1 and 2, except that they were not fed lead acetate. The distal portions of the left femur and left tibia of the animals were examined roentgenologically before lead feedings were begun on April 30, 1930. At this time the roentgenologic findings in the femora and tibiæ of both control and experimental animals were practically identical. Roentgen examinations of these same bones were made 10 and 17 days after the lead feeding began on Animals 1 and 2. After 10 days the ends of the femora and tibiæ in Animals 1 and 2 showed bands of increased density which were not present at the beginning of the feeding period and were not present in the bones of control Animals 3 and 4 at the end of the tenth day. On the seventeenth day of the experiment (Fig. 9-*A*), the increase in density at the ends of the bones of Animals 1 and 2 was both greater and wider than on the tenth day and, when comparison was made with the roentgenograms of the corresponding bones of the control animals, it was seen clearly that lesions were developing only in the animals that were eating lead.

Chemical Analysis.—The same method and technic were used as described for Clinical Case 3 except that the shafts of the femora, tibiæ, humeri, and radii were used. Here again the segments of bone taken from the ends of the shafts probably contained some normal bone contiguous to the zone of the roentgenologic lesion, lying shaftward in the bone. Thus again the lead content of the narrow terminal portion of the bones was probably actually greater than analysis of the segment indicated.

Specimens from Ends of the Bones.—Animal 1. Pooled discs of bone from ends of the femora, tibiæ, radii, ulnæ, and humeri contained 1.5 mg. of lead per gram of dry specimen.

Animal 2. Pooled discs of bone from ends of the femora, tibiæ, radii, ulnæ, and humeri contained 0.85 mg. of lead per gram of specimen examined.

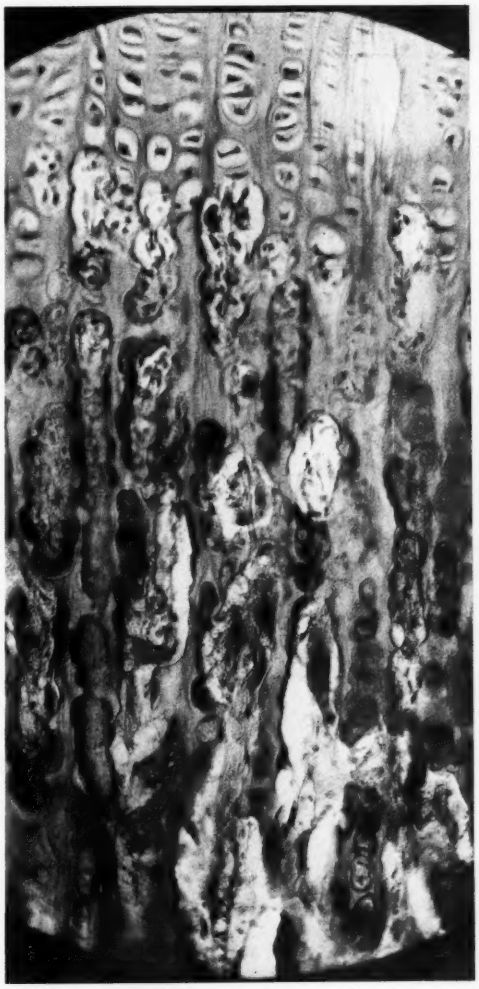


Fig. 8-*D*. Magnification × 275 shows detail of the sub-epiphysial zone, with closely packed trabeculæ and partial obliteration of the marrow space. (See 8-*A* and 8-*B*.)

Animal 3 (control). Pooled discs of bone from ends of the femora, tibiæ, radii, ulnæ, and humeri contained 0.08 mg. of lead per gram of specimen examined.[6]

Specimens from Remainder of Shaft.—Animal 1. Remainder of the shaft con-

[6]Presence of small amount of lead in Control 3 is probably due to the fact that this dog was kept in the same pen as the experimental animals and possibly obtained lead from ingestion of lead-containing feces, or from licking mouths of the animals receiving lead.

tained 0.144 mg. of lead per gram of specimen.

Animal 2. Remainder of the shaft contained 0.508 mg. of lead per gram of bone.

Animal 3 (control). Remainder of the shaft contained 0.055 mg. of lead per gram of the specimen.

Conclusion.—(a) Ingestion of lead by growing dogs caused bands of increased density at the ends of the long bones similar to those seen previously in the roentgenograms of the long bones in children with chronic lead poisoning. These changes were visible as early as the tenth day of the ex-

Figs. 9-*A*, 9-*B*, and 9-*C*. The changes in the bones in experimental animals after ingestion of lead.

Fig. 9-*A*. Animal No. 1, Experiment I, before feeding lead and at the seventeenth day. Note bands of increased density at the ends of the bones similar to those in clinical lead poisoning.

periment and had increased in size and degree of density by the seventeenth day.

(b) The lead content of the juxta-epiphysial portion of the shaft, which appears in the roentgenograms as a transverse band of increased density, is from ten to twenty times as great as the lead content of the corresponding portions of the same bone in the control animals.

(c) The lead content of the ends of the bones (site of the roentgenologic increase in density) was approximately four times as

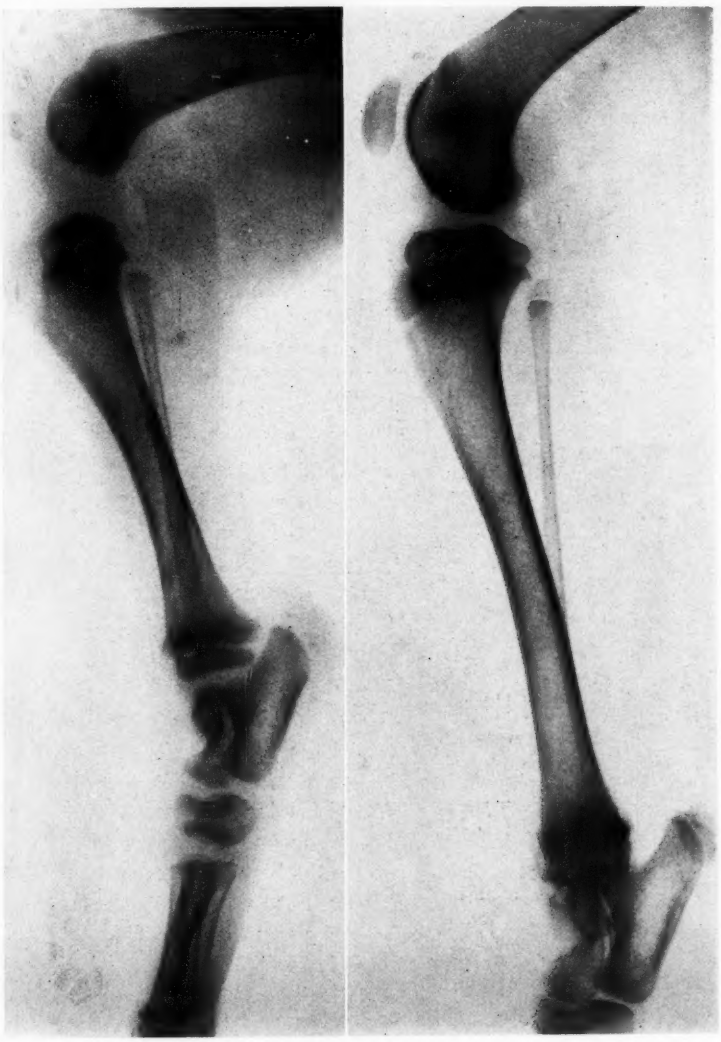


Fig. 9-*B*. Roentgenogram of bones before and on the fifty-fourth day of lead feeding in Dog 224, Experiment II. Note bands of increased density at the ends of the bones.

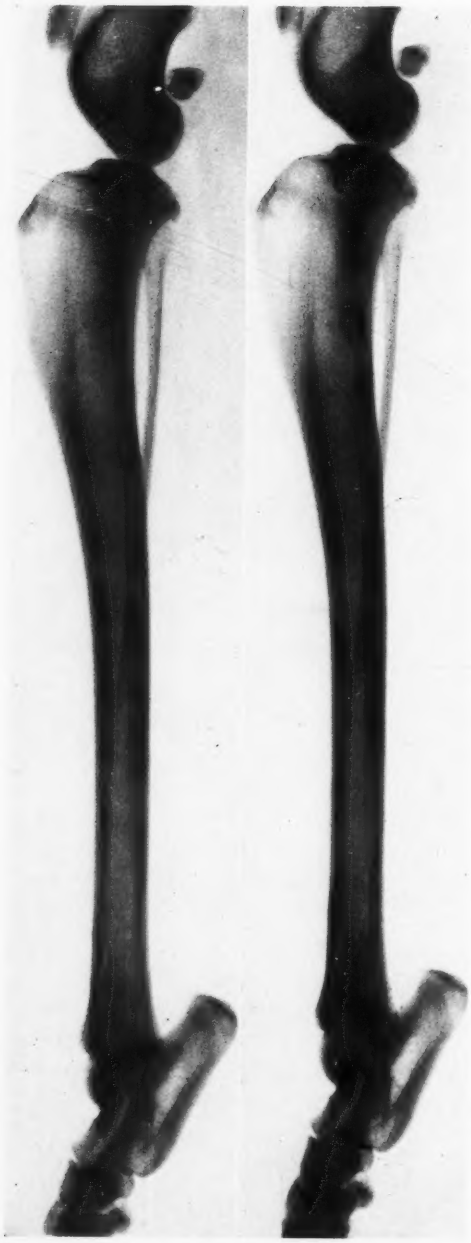


Fig. 9-*C*. Adult dog before and on the seventy-ninth day of lead feeding. No changes similar to those seen in growing dogs are visible.

great as the lead content of the remainder of the shafts in Animal 1, and one and six-tenths times as great as in Animal 2.

EXPERIMENT II

Purpose.—To repeat the observations made in Experiment I and to determine microscopic findings at the ends of the shafts which show increased opacity to the X-ray.

Procedure.—Two young dogs (224 and 225), litter mates, approximately 9 weeks of age, were kept under identical conditions and in separate pens. Animal 224 was fed by mouth large amounts of lead acetate (10 per cent). Roentgen examinations were made of left fibula and tibia before the experiment, and on the seventeenth, forty-fifth, and fifty-fourth days of the experiment. No abnormal roentgen changes were seen in the films of Dog 225. The roentgenograms of Dog 224 that was receiving lead by mouth showed bands of increased density at the ends of the bones definitely on the fifty-fourth day (Fig. 9-*B*). These changes could not be made out with certainty on the seventeenth day. This difference in the time of development of the lesions in the two experiments is possibly due to the variable amounts swallowed and absorbed when dogs are fed lead solutions by a dropper. The dosage and frequency of feeding lead are approximately the same as in Experiment I. Lateral views of the skeletons of the experimental and control animals are shown (Figs. 11-*A* and 11-*B*) after 54 days of feeding lead to Dog 224. In these roentgenograms it is apparent that, in addition to the bands of increased density at the ends of the long bones of the extremities, similar changes have developed at the terminal ends of the ribs. These lesions were described in detail by Park, Jackson, and Kajdi (3) and were also observed by Vogt (4) in chronic lead poisoning in children.

Microscopic.—Microscopic changes are present at both ends of the tibiæ, although only proximal ends are shown in Figure 10-*B*. There is a marked increase in the number of trabeculæ and a packing together with the resulting partial obliteration of marrow

space in the juxta-epiphysial portion of the shaft which shows as increased density in the roentgenograms. This transverse layer of compact, young, osseous tissue, lying contiguous to the proliferating cartilage, was also visible in gross examination after longitudinal section of the bone. No similar changes are seen in the same bones in control Animal 225 (Fig. 10-*A*). The microscopic lesions in Animal 224 are similar to those seen in the bones of Case 3.

Chemical Analysis.—The same method and technic of examination were used as in Case 3 and Experiment I. In Animal 224, discs from the ends of the long bones contained 165.3 mg. of lead per gram of dry specimen. The remainder of the shaft is the long bones contained 64.7 mg. of lead per gram of specimen.

Conclusion.—*(a)* Roentgenologic lesions similar to those produced in Experiment I were again produced at the ends of the long bones in a growing dog by feeding lead. The lesions in this case developed more slowly than in Experiment I. Changes at the sternal ends of the ribs were also demonstrated in this animal in Experiment II.

(b) Microscopic examination of the bones shows the same changes in trabeculation (hyperplasia and packing together of bony trabeculation with partial obliteration of the marrow space) as seen in the human bones in Case 3.

(c) Quantitative chemical analysis shows the lead content of the terminal portions of the bones (the site of the roentgenologic and microscopic lesions) to be approximately two and one-half times as great as of the remainder of the shaft.

EXPERIMENT III

Purpose.—To determine effect of feeding lead on the skeleton of a fully grown dog.

Procedure.—Animal 199, fully grown as evidenced by the complete ossification of the epiphysial cartilages and their fusion with the diaphyses, was fed, over a period of 79 days, large amounts of lead acetate (10 per cent). Roentgen examinations at intervals and at the end of this period show no changes in the long bones (Fig. 9-*C*).

Microscopic.—Examination of the tibiæ shows no abnormal changes.

Chemical Analysis.—Shows the lead content of this bone to be 0.052 mg. per gram at the end of the bones. No lead could be demonstrated in the remainder of the shaft.

Conclusion.—The ingestion of large amounts of lead by a fully grown dog produced no roentgenologic or microscopic changes in the skeleton comparable to those produced in Experiments I and II by feeding lead to growing dogs.[7] (The duration of the chronic poisoning and observation here was only 79 days. Chronic lead poisoning in humans often extends over several years.)

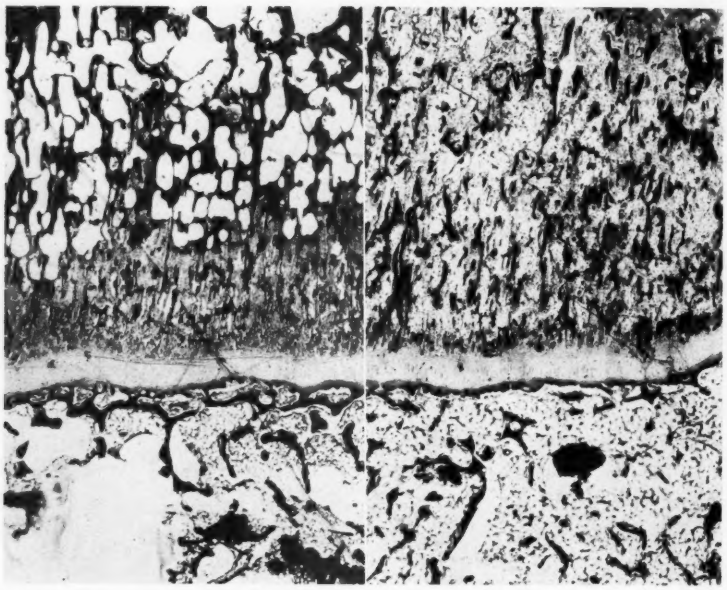
COMMENT

Recent reports on infantile and juvenile lead poisoning by Park (5), by Park, Jackson, and Kajdi (3), and by Vogt (4) describe roentgenologic changes in the growing skeletons similar to those reported here. Previous to Park's recognition of these lesions in April, 1929, the roentgenologic changes in the growing skeletons of infants and children had not been appreciated. Vogt also recognized these lesions several weeks (August, 1929) before my first observations in Case 1, October, 1929. As stated in the introduction, the chemical studies of Minot and Aub (1) on the distribution of lead in the tissues, and their conclusion that bony trabeculæ were the important site for deposition of lead, first suggested and were responsible for the roentgenologic examinations in the three cases reported here.

The effect on growing bones of the ingestion of phosphorus has been known since the

[7] To date we have been unable to produce these lesions by feeding lead to growing guinea pigs, growing rabbits, and the chondrodystrophic type of growing dog.

observation of Wegner in 1872 (6), who found much new bone formation along the diaphyseo-epiphysial junctions resulting in dense layers of bone in the ends of the shafts, which varied in width (longitudinal) with the duration of phosphorus administration. He pointed out at this time that adult bones do not show similar changes after ingestion of phosphorus. Forty-six years later, Phemister (7) demonstrated the roentgenologic effects of phosphorus on growing, normal, and diseased bones. Phemister described heavy, broad shadows at the ends of the shafts of each bone, "being broadest in the femora where the longitudinal growth is the greatest." He also described changes in the epiphyses which consisted of "fairly dense narrow shadows about the periphery of the ossification centers." A recent report by McLean, McDonald, and Sullivan (8) of a fatal case of acute phosphorus poisoning in a child indicates that no roentgenologic changes occurred in the bones in this acute case, although the roach paste ingested contained 1.19 per cent elementary phosphorus.



Figs. 10-*A* and 10-*B*. Microscopic changes at the end of the proximal tibia.
Fig. 10-*A* (*left*). Control animal No. 225, showing normal trabeculation at the end of the bone. (Magnification × 15.)
Fig. 10-*B* (*right*). Dog No. 224, showing a narrow band of increased trabeculation adjacent to the epiphysial cartilage. Note the similarity between this change and that seen in Fig. 8-*C*. (Magnification × 15.)

It is probable that the anatomic changes in the growing skeleton after chronic lead and phosphorus poisoning are similar, if not identical. It is possible that other metals, or even non-metallic poisons, may affect growing bones in a similar way. This, however, is problematical at the present time. We have seen increase in density at the ends of the long bones after excessive viosterol administration which, while not so marked, suggests roentgenologically the changes seen in chronic lead and phosphorus poisoning. However, we have not had the opportunity of examining such bones microscopically. Hess and Weinstock's studies (9) on the value of elementary phosphorus in rickets

indicate that there is a wide difference in the modes and site of action of Vitamin D and phosphorus in the growing skeleton. The effect of irradiated ergosterol, of ultraviolet light, and of exposure to the roentgen ray in normal growing bones is the subject of some experimental investigations being carried on at the present time. At the Babies' Hospital, we have had a large group of syphilitic infants and children under observation for months and years who have received intravenous and intramuscular administrations of mercury, bismuth, and arsenic over long periods. The bones of these patients have been repeatedly examined roentgenologically and to date we have not seen changes comparable to those occurring in chronic phosphorus or lead poisoning. The effect of these metals in toxic dosage on growing bones is, of course, another question, because the dosage used for antisyphilitic therapy is hardly comparable to the massive dosage involved in experimental and clinical lead poisoning.

The roentgenologic and microscopic distribution of lead lesions in the skeleton and the difference in degree of involvement in different bones and in different ends of the same bone indicate clearly that the changes seen are closely associated with growth. The more rapidly growing portions of the bones (distal femora) show the greatest changes, while the slower growing portions of the bones (proximal ulnæ, radii, and distal humeri) show very little change. The absence of lesions in the distal end of the first metacarpal is notable since changes develop on the distal ends of the four other metacarpals.

There was also a decided difference in the degree of roentgenologic change in the three clinical cases. The widest bands of increased density are seen in Case 2, suggesting a longer period of ingestion of lead, or perhaps more rapid growth in this case. The former appears the more likely since Case 2 is older than Case 1. Also in Case 2 there were more numerous, narrower, fainter, and more widely separated bands of increased density shaftward in the bone, which may indicate a more chronic and irregular ingestion of lead over longer periods than in the other two cases. The history in Case 2 is not clear as to exactly when the child began eating lead, but a period of long duration seems likely. Both Cases 1 and 3 apparently began eating lead approximately four months previous to the first examination. The lesions in Case 1, the younger (18 months) and more rapidly growing, are much better developed than in Case 3, the older (3 years) and more slowly growing, although in the latter case the lead intoxication was sufficiently severe to terminate fatally. The importance of growth in the development of these lesions is shown even more vividly by the absence of any changes in the portions of the shaft in which longitudinal growth is complete. This probability is also strengthened by failure to produce changes by feeding lead to the adult dog in Experiment III. The necropsy reports of Aub, Minot, and Reznikoff (10) and Lewin (11) indicate that there are no anatomical changes in adult bones in chronic lead poisoning. I have been unable to find roentgenologic observations on the skeletons of adults during active chronic lead poisoning.

The roentgenologic sequelæ in the two patients who recovered, Cases 1 and 2, appear to be very similar in the diaphyses, but differ decidedly in the ossification centers of the epiphysial cartilages and in the bones of the carpus. In the follow-up observations, the growing diaphyses are seen to grow beyond the levels of the lesions which now appear buried into the shafts as narrower, fading transverse bands of increased density, containing a heavier trabecular pattern than the remainder of the bone. A surprising finding is that new bands of increased density form juxtaepiphysially in the immediate zones of

growth during follow-up periods. This latter feature may be due either to a recurrence of the ingestion of lead by these patients at home, after discharge from the hospital, or to the fact that there is a retention of lead in other tissues and a gradual release into the blood after actual ingestion of the metal has stopped which can still produce the deposition in and the toxic effect of lead on the growing portions of the

Fig. 11-*A*. Roentgenogram of skeleton of control dog No. 225 on the fifty-fourth day of the experiment showing normal roentgen findings.

bones. The nature of the sequelæ in the carpal bones and epiphyses appears to be identical, except that, in the shafts, the growing metaphysis is a transverse zone, and, in the carpals and epiphyses, the growing portion of the bone is a narrow, ovoid zone. These changes appear similar to those described as sequelæ in scurvy by Reyher (12) and later by Wimberger (13). The presence of sequelæ in the carpals and epiphyses in Case 1 and their absence at these locations in Case 2 are striking. This may be due to the more rapid growth of the younger patient, Case 1, aged 18 months. Also administration of irradiated ergosterol in the first case may be significant. Although the dosage was not large and the period of administration was short, it is possible that the bones during lead poisoning are more susceptible to the action of irradiated ergosterol.

The differential roentgenologic diagnosis in these lesions may present considerable difficulties if cases of lead poisoning are encountered early. In particular, infantile syphilis and scurvy cause narrow transverse bands of increased density at the diaphyseo-epiphysial junctions which may be confusing if a "lead line" is also narrow. The changes in Case 3 exceed only moderately the bands of increased density which are seen at the ends of the bones in children who are free from lead poisoning, but who present clinical pictures of anemia, miliary tuberculosis, celiac disease, chronic infections, and malnutrition of a variety of types. Vogt (4) has pointed out the resemblance of certain stages of healing rickets and lesions of Albers-Schönberg's disease to the changes seen in his cases of chronic lead poisoning. We have previously mentioned the roentgenologic similarity of the so-called "hypercalcification" of the metaphyses seen after excessive dosage with viosterol, to the changes in lead poisoning. The anatomic findings in Case 3 and in the experimental animals show that there are pronounced changes in the bony structure at the ends of the shafts. A narrow transverse layer of dense compact osseous tissue situated contiguous to the epiphysial cartilage can be made out in the gross specimen after longitudinal section. Microscopically this dense zone is seen to consist of large numbers of closely packed trabeculæ of smaller caliber than normal. This increase in number and concentration of bony trabeculæ results in partial obliteration of the marrow spaces. The increase in the number of the more radio-opaque trabeculæ and their substitution for the more radio-translucent marrow spaces in the terminal portions of the bone seem sufficiently pronounced to produce bands of increased density seen at the ends of the long bones in the roentgenograms.

The chemical analyses of the bones showed increased lead content for all portions of the bone during lead poisoning. In addition, it appears certain that the lead content of the terminal portion of the bones is greater than the remainder of the shafts, approximately two and one-half to three times greater, under the conditions of these observations. This increased lead content at the ends of the shafts might be explained simply by the increase in the trabecular bone in these areas, since Aub (2) has shown that lead storage occurs only in solid portions of cancellous bones. Vogt (4) found that the zone of greatest density in the roentgenogram contained less calcium, but four times as much lead as the cortex. This led him to the conclusion that the opacities seen by the X-ray are due to the high concentration of lead at these points.

The anatomical changes seen in these bones, first recognized by Park, and confirmed in this report, appear to be the major factor in the production of bands of increased density seen at the ends of the bones in the roentgenograms. A lead storage in high concentration at the ends of the bones may be an additional factor in the production of heavy shadows seen roentgenologic-

ally. This question must remain problematical until more chemical data are available.

SUMMARY

Three cases of chronic lead poisoning in children are reported, all of which showed changes in the roentgenograms of the long bones.

The roentgenologic changes consist of increase in the density of the growing portions of the skeleton. The slow growing and non-growing portions of the skeleton appear normal roentgenologically.

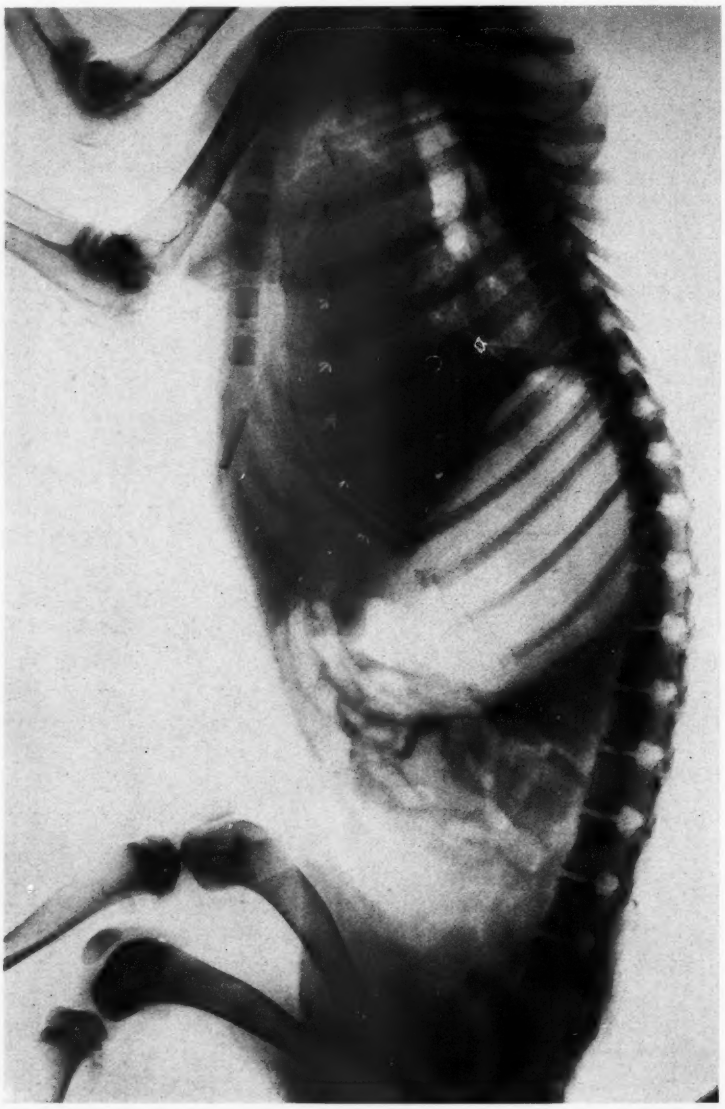


Fig. 11-*B*. Roentgenogram of skeleton of "lead dog" No. 224 on the fifty-fourth day of the experiment showing bands of increased density at the sternal ends of the ribs. Changes can also be made out clearly at the ends of the long bones of the extremities.

The roentgenologic sequelæ in the bones of two children who recovered are described. These consist of a series of "transverse lines" left behind in the diaphyses and linear rings of density in the ossification centers of the epiphysial cartilages and the carpal bones, similar to those previously reported as pathognomonic of healed scurvy.

In one case, necropsy with gross and microscopic examination of the distal end of the femur indicated that, roentgenologically, there is pronounced anatomic change present at the sites of increased density. The anatomic change consists of a hyperplasia and packing together of trabecular bone in a narrow zone contiguous to the proliferating cartilage.

The roentgenologic and anatomic findings in bone in clinical cases of chronic lead poisoning were reproduced experimentally by feeding lead to growing dogs.

Chemical analyses of both human and dogs' bones indicate a lead deposit throughout the bones, with a higher lead content in the sub-epiphysial zones of roentgenologic and anatomic change than in the remainder of the shaft.

Lead feeding for 79 days in one fully grown dog resulted in no change either roentgenologically or microscopically, although lead was detected in these bones chemically.

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CARCINOMA OF THE MAXILLARY ANTRUM[1]

THE TECHNIC OF TREATMENT

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IN the treatment of carcinoma of the antrum a clear conception of the disease and accuracy of detail are essential to care successfully for the many complications which may be encountered. It is the purpose of this discussion to present the technical procedures by irradiation and surgery. At Memorial Hospital, recent advances in the diagnosis and treatment of carcinoma in general have been furthered by the development of a method for measuring the minimum dose of radiation delivered to the lesion, and by a method of immediate histologic diagnosis. Their application to carcinoma of the antrum, with the principles of surgical exposure and drainage, promises better results in the future, not only with the operable, but particularly with the inoperable cases.

A review of the literature reveals only a small percentage of patients well five years from the first appearance of the lesion, after any type of treatment. Until recently the principal treatment has been surgical excision of the tumor-bearing area. In regard to the resection of the superior maxilla for carcinoma, Scudder said that even the most painstaking surgery rarely succeeds, and that success by this means is the exception rather than the rule. The primary cause for surgical failure is the inability to resect widely enough. An important secondary cause is the high operative mortality, which has been reported by Schley (31) to be from 12 to 13 per cent in America, and even higher in Europe.

New (26) reported the results of a carefully selected series of cases treated at the Mayo Clinic. He concluded that coagulation over a long period of time by cautery in the form of soldering irons, followed by radium treatment, eliminated to a considerable degree the operative mortality, and cured more patients than operative methods had previously done.

Quick (27, 28) formulated the present principles and demonstrated the actual possibilities of irradiation in the treatment of carcinoma of the antrum. He stated that radium and X-rays may be depended upon to eradicate the tumor tissue if applied accurately and uniformly throughout the growth in sufficient dosage. He stated further that surgery must be employed to provide exposure and drainage for radium application. The technical procedures employed at Memorial Hospital are based on these principles, and are found to be highly efficient.

SYMPTOMS

Carcinoma of the antrum may produce signs referable to the nose, orbit, or teeth, long before an associated neoplasm is suspected. Empyema of the antrum is frequently suspected and conservative drainage instituted. The primary symptom frequently furnishes valuable evidence in determining the origin of the growth. For instance, if the growth arises in the ethmoid area or involves the floor of the orbit, ocular derangements, with swelling of the lids, and conjunctivitis and lacrimation, are prominent clinical features. In case it arises on the floor of the antrum, in the mucoperiosteal lining, in a perforating tooth socket, or in an embryonic rest, the symptoms are dental. Repeated and time-consuming extractions usually follow.

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1 to 5, 1930.

The growth quickly fills the antral cavity and may encroach upon the orbit, naris, lacrimal duct, infra-temporal fossa, or the mouth. Fungation may occur through the antral orifice or bony wall into the nose, or through a tooth socket, frequently following a recent extraction. Unless the process is interrupted, erosion and infiltration of the walls are inevitable. It is with this process that the persistent aching pain begins over one or more branches of the trigeminal sensory distribution. Bone invasion is accompanied by osteomyelitis, with the clinical picture of infection. The anterior wall of the antrum and the floor of the orbit are thin and one or the other is usually perforated first, depending upon the origin of the growth. Perforation of the anterior wall causes a swelling of the cheek and lower eyelid, and a swelling may appear anteriorly between the cheek and upper alveolar ridge. Perforation of the floor of the orbit is accompanied by swelling of the lids, conjunctivitis, exophthalmos, and functional ocular disorders. Extension through the hard palate is usually late in the course of the disease. Likewise, invasion of the posterior wall of the antrum or malar surface of the superior maxilla, into the infra-temporal fossa and thence into the pterygomaxillary fissure to the base of the skull, is a common late manifestation of the disease. This path of extension is frequent and such symptoms accompany it as anesthesia in the distribution of the second and third branches of the nerve trigeminus, fixation of the jaws, pa-

Fig. 1. Case 1. Photomicrograph of tissue from fungating growth showing squamous-cell carcinoma.

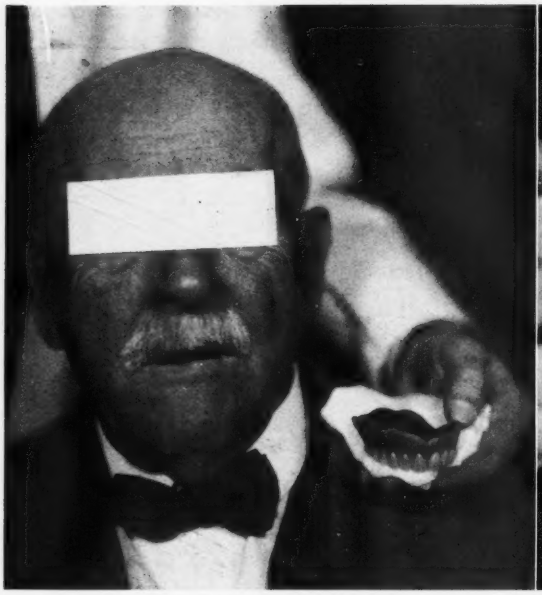

Fig. 2. Case 1. Patient has been well for nine years. The normal facial symmetry has been preserved. The denture is shown with the mold appliance for an edentulous mouth.

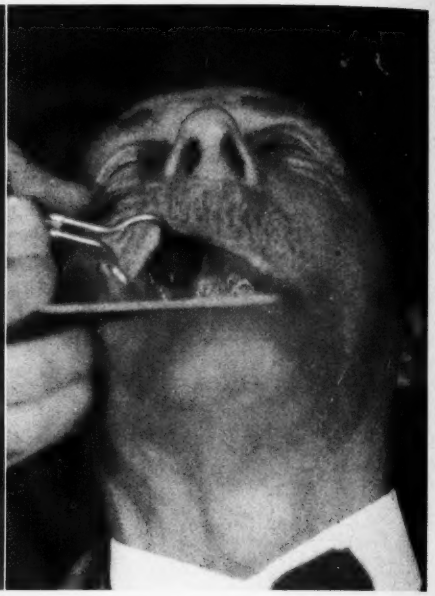

Fig. 3. Case 1. Intra-oral view of the aperture in the floor of the antrum which includes a segment of the alveolar process and hard palate.

ralyses of certain extra-ocular muscles, and, finally, a severe and persistent headache from meningeal irritation.

When carcinoma develops in an already diseased antrum, the new symptoms merely intensify the existing ones. The signs and symptoms appear to be inflammatory in nature until a late stage of the disease.

DIAGNOSIS

As a rule, the diagnosis of carcinoma of the antrum is not made until it is self-evident. This is explained in part by the fact that a deep-seated tumor rarely occasions symptoms until growth causes mechanical pressure on the surrounding structures. Infection also complicates the diagnosis and blurs the boundaries of the tumor-bearing area. The factor of most importance, however, is the failure to suspect neoplasm as a possibility in disorders of the antrum. In 1930, Quick (28) reported 136 malignant growths of the antrum and demonstrated 83 per cent to be in the inoperable group on admission. Further, 45 per cent of the patients had had various local operations on their nasal passages which did not reveal the true character of the disease. Obviously, to institute biopsy in all operative procedures as a routine measure would overcome much delay.

The experience at Memorial Hospital has not shown radiographs to be of diagnostic value in differentiating between a strictly inflammatory process and newgrowth in early stages of the disease. In the advanced stages, when the differentiation is obvious, it furnishes confirmatory evidence. The value of stereoscopic radiographs is not in the diagnosis, but in establishing the extent of newgrowth invasion, where bone involvement has already started. The roentgenologic opaque solutions and transillumination have not proven of value in routine examinations in our hands.

Diagnosis by Biopsy.—Ordinarily there are sufficient reasons for suspecting carcinoma, and a tentative diagnosis may be easily made, but the final diagnosis can be made only from histologic study. In patients with ulcerating tumor tissue presenting in the nasal passage or in the oral cavity, the biopsy may be taken without delay, and without resorting to an operative procedure. The majority of patients is included in this group.

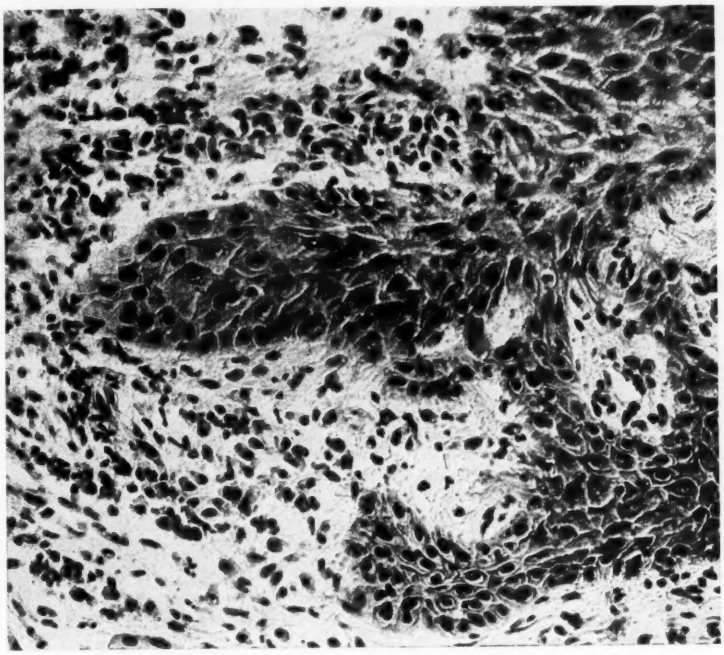

Fig. 4. Case 2. Photomicrograph of antral tissue removed at antrotomy showing squamous carcinoma.

Diagnosis by Aspiration. — Histologic study of tissue aspirated from a series of cases with tumors of the antrum has been reported by Martin and Ellis (20). Their results showed that the information gained in this manner has been of value in establishing an immediate histologic diagnosis.

The method they describe has certain definite advantages over the former biopsy for carcinoma in the antrum. Of these may be mentioned the simplicity of the technic of obtaining the material for study, a procedure which may be carried out in the out-patient clinic with little inconvenience to the patient; and finally it permits of immediate irradiation without the lapse of time necessary for hospitalization.

Certain theoretical disadvantages may be claimed for this method, although all that might be mentioned apply more directly to the operative biopsy than to aspiration. For example, the dissemination of the tumor by trauma, the implantation of tumor cells along the needle tract, the inability to obtain tissue or the inability to differentiate the tissue obtained, may all be considered. With intra-oral biopsy the introduction of infection with subsequent fungation is frequent with the rapidly growing carcinomas. None of these complications has been of any practical importance to date. However, the

unusual demands placed upon the pathologist in reaching conclusions from a study of such a small amount of tissue should be kept in mind. The latter consideration is the one which is most likely to limit temporarily its field of usefulness.

Martin and Ellis demonstrated that aspiration was an important diagnostic procedure for early carcinoma of the antrum, and four positive aspiration diagnoses were reported in their paper. Others have been added (5), and now a wide range of malignant disease of the antrum is included in the series, with a diagnosis by aspiration. (See Table A.)

For details of the method, reference should be made directly to the original paper by Martin and Ellis (20).

As shown on Table A, there are several sites for aspiration. Selection is based upon the direct invasion of bone or upon pressure absorption in the advanced cases, or through the middle meatus of the nose in early cases, as is frequently done with the diagnostic punch for empyema.

The preliminary summary of the results by the aspiration method demonstrates it to be efficient in all types of growth of the antrum. This method might well be adopted as a routine diagnostic procedure for disorders of the antrum.

HISTOLOGY

The exact origin of carcinoma of the antrum is rarely determined and in many patients with extensive involvement it is even very difficult to determine whether the antrum was involved primarily or secondarily. The histology of the growth is of assis-

TABLE A.—HISTOLOGIC DIAGNOSIS BY ASPIRATION

Patient	Site of aspiration	Aspiration diagnosis	Aspiration diagnosis confirmed by biopsy
1. A. G.	Cheek and anterior wall of antrum	"Adenoid cystic carcinoma"	"Adenoid cystic epithelioma, cellular, malignant"
2. V. S.	Cheek and anterior wall of antrum	"Cellular Schneiderian carcinoma, radiosensitive"	"Cellular Schneiderian carcinoma, Grade II, moderately radiosensitive"
3. S. B.	Cheek and anterior wall of antrum	"Cellular carcinoma, small cells, radiosensitive"	"Cellular carcinoma, Grade II, relatively radiosensitive"
4. P. V.	Hard palate	"Osteogenic sarcoma"	"Osteogenic sarcoma"
5. L. B.	Hard palate	"Chondrosarcoma"	"Chondrosarcoma"
6. K. M.	Cheek and anterior wall of antrum	"Papillary epidermoid carcinoma, Grade II, radiosensitive"	No biopsy
7. N. M.	Hard palate	"Chronic inflammation, no tumor"	"Chronic inflammation"
8. H. A.	Hard palate	"Adenoid cystic carcinoma"	"Adenoid cystic carcinoma"
9. G. O.	Cheek and anterior wall of antrum	"Glandular carcinoma, adenoma, malignant"	"Carcinoma, mixed type, probably glandular"
10. J. P.	Cheek and anterior wall of antrum	"Transitional-cell carcinoma"	"Some islands of atypical epithelial cells suggestive of epidermoid carcinoma"
11. P. K.	Intra-oral swelling along alveolar ridge	"Epidermoid carcinoma"	"Epidermoid carcinoma, Grade III, radiosensitive"
12. C. R.	Intra-oral swelling along alveolar ridge	"Schneiderian carcinoma"	"Cellular Schneiderian carcinoma, Grade III, radiosensitive"

tance. It is possible for all types of carcinoma found in the antrum to arise there primarily. The determination of the origin is, therefore, a deduction based chiefly on the primary symptoms, the examination, and the clinical course of the growth.

Carcinoma is the predominating type of tumor found in the antrum: Ewing (12) describes five different types. The antrum is lined by a ciliated cylindrical-cell membrane and the most common type of carcinoma is the adenocarcinoma derived from this layer. It is a rapidly growing tumor, bulky, and it invades the bony walls early. Schneiderian carcinoma commonly arises from the mucous membrane of the nose, but it has also been demonstrated primarily in the antrum. It is a rapidly growing, vascular tumor simulating closely lymphoepithelioma. Infiltration of the soft and osseous tissues occurs early. Squamous-cell carcinoma is frequently found to invade the antrum secondarily but it may arise from the mucous membrane, particularly in an inflammatory antrum. Basal-cell carcinomas are ordinarily of more slow growth and less malignant than other types and are usually not recognized until late. This group may or may not have adenoid cystic features. Finally, transitional-cell carcinoma arises in the antrum although this is some distance from its common site. The primary tumor grows slowly and remains symptomless until late. Ordinarily metastases occur early and grow rapidly, but in the antrum this is rarely true. In fact, early metastases are very rare in any type of carcinoma in this location.

It is evident that infection plays an important rôle in the etiology of carcinoma of the antrum. Recent histologic studies on degenerative and regenerative changes in the mucoperiosteum of chronically diseased antra are a promising field of research. Knowlton (17), Gorham (13), and Emerson (11) have shown that epithelization following radical surgery for chronic infection takes place in an unusual manner. In a preliminary report Knowlton has shown in dogs that regeneration begins promptly with the basal layer, spreading out over the granulations, followed by the columnar epithelium and finally the development of the ciliated cylindrical-cell antral lining. Emerson studied the atrophic changes, although the histologic phase of the work was incomplete. The reaction of mucous membrane to chronic inflammatory conditions of the antrum is an important problem in relation to the etiology of carcinoma.

TECHNICAL CONSIDERATIONS OF TREATMENT

The principle of trial and error with the surgical treatment of carcinoma of the antrum has been demonstrated to be of little curative value. The complications associated with surgery alone may appear equally serious, with the addition of irradiation. Many factors must be considered, such as the anatomical relations, the close proximity to bone, the histologic structure of the tumor, the origin and degree of infiltration, and the presence or absence of infection. Due consideration of these facts has demonstrated the necessity for a methodical scheme of treatment which accurately cares for all phases of the growth. Experience during the past few years has shown that the so-called treatable patients are increasing, while those suitable only for palliation are decreasing in numbers.

Exposure.—The antrum is a cavity surrounded by bone with one small opening into the nose, the antral foramen, with its orifice in the middle meatus. Exposure aims toward providing an opening in this bony cavity to arrest infection if present and to provide an accessible opening for the implantation of radium. Among our patients frequently an opening is already present from an earlier operation or a recent extrac-

tion; bone absorption and fungation of the growth through one or more of the walls may have already occurred. Among the so-called operable patients without bone invasion and in the advanced patients in whom

Fig. 5. Case 2. View of the orbit looking into the antrum from above. The type of denture and mold projection for an edentulous mouth is shown.

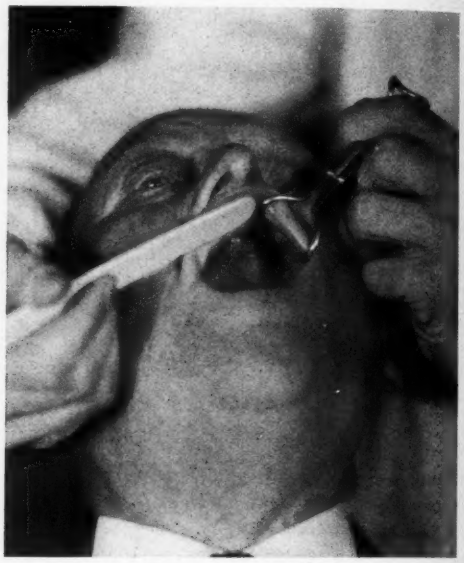

Fig. 6. Case 2. Intra-oral view of the aperture into the floor of the antrum.

there is any question of an inadequate exposure, the anterior wall of the antrum may be exposed intra-orally under block anesthesia and a portion of bone removed from it. Care is taken to avoid traumatizing the tumor tissue within as much as possible. This precaution is primarily to save excessive bleeding in the operative field, which would otherwise interfere with the immediate implantation of gold seeds containing radon. Also, it is essential that the growth remain intact in order to hold the gold seeds in place. The less trauma there is, the less the danger of metastases. If bleeding is excessive, it is well to pack the area and implant the gold seeds later in a dry field. The accuracy of this procedure is of the utmost importance in preventing a late recurrence of disease.

The Radiation Dose.—Recent advances in the irradiation treatment of carcinoma in general have been made as a result of the accurate methods devised by Martin and Quimby (19), at Memorial Hospital, for estimating radiation doses. The empiric doses of years past are replaced by calculated irradiation treatments based upon the time interval of treatment, the location, depth, size, and histologic structure of the tumor. Their work is published in detail elsewhere, so that only the practical features as related to the treatment of carcinoma of the antrum are emphasized here. They have calculated the actual dose in a large series of successfully treated patients and have found that, for the adult types of epithelial tumors, a dose of radiation ranging between seven and ten erythemas is apparently necessary for successful eradication of the disease.

An estimation of this "tissue dose," which is the minimum number of skin erythema doses of radiation delivered to any part of the tumor, is based upon the several factors

mentioned above. It is difficult to measure the size of antra directly and to determine the degree of carcinomatous infiltration. Anatomists have had great difficulty in determining the cubic volume of antra without of dosage calculation all lesions are treated as spheres; the diameter of a sphere corresponding to the above volume is 3 centimeters. Antra are, therefore, considered to have this average diameter. The depth of

Fig. 7. Case 3. Photomicrograph of tissue from fungating growth in nasal cavity showing adenoid cystic epithelioma.

dissection. An average volume, therefore, based upon anatomical studies, would perhaps afford a more accurate estimation than individual measurements. This seems to be a fair assumption, as we are dealing with a cavity in the bony skeleton. Braune and Clasen (3), Brühl (4), and Loeb (18), determined the cubic volume of forty pairs of antra by making molds with plaster of Paris and dissecting them out. The average cubic volume for all of their antra was approximately 12 cubic centimeters. In our method the tumor also is important for estimating the amount of radiation delivered to the tumor by external sources. Allowing 1 cm. for the depth of the anterior wall of the antrum from the surface of the skin, a distance of 4 cm. will then be roughly the greatest depth of growth extension. At present the histologic structure of the tumor is not considered because of the high percentage of patients with bone invasion already present. It is assumed that, regardless of the type of tumor invading bone in this

region, the lethal dose of from eight to ten skin erythemas (800-1,000 per cent S.E.D.) is necessary, as required for squamous carcinoma. Finally, the most efficient time period of treatment has not been determined experimentally, but it is considered essential to deliver the maximum tissue dose within at least a thirty-day period.

External irradiation may well be given first. There is the theoretical advantage from the effects of external treatment when the interstitial irradiation is given. Also, this may be given without loss of time during the preliminary blood studies, X-ray examinations, and histologic diagnosis and grading. The X-radiation is given ordinarily by one high voltage exposure of sufficient intensity to deliver one full erythema dose to the skin over the antrum. If, on the other hand, heavily filtered radium is given with the four-gram radium pack, 16,000 milligram-hours at a skin distance of 6 cm. will furnish approximately the same dose on the skin surface. By either means, the tissue dose to the depths of the tumor is between 50 and 90 per cent of a skin erythema. In cases in which palliation only is expected, treatment of the primary lesion is confined to repeated cycles of this type of irradiation. However, external irradiation will not permanently control carcinoma of the antrum.

In cases in which eradication of disease is the objective, interstitial irradiation must be employed. Filtered radium emanation in gold seeds is the most satisfactory means at present of delivering the necessary dose of radiation in as uniform a manner as possible. The tissue dosage calculations of Martin and Quimby show that a sphere 3 cm. in diameter must receive between 16 and 20 millicuries of radon in gold seeds in order to receive a minimum lethal dose of S.E.D. This would represent the treatment necessary for an early carcinoma of the antrum in which X-ray examination shows no invasion or absorption of its walls. On the other hand, antra having carcinomatous invasion of one or more of the walls are considered to have a diameter 1 cm. greater than those without such invasions. Therefore, the advanced carcinoma of the antrum must receive between 23 and 29 millicuries to deliver between eight and ten skin erythema doses. Any smaller amount must be considered to be a sublethal dose (Case 3).

The radon implants are left for from twelve to fourteen days, at which time the radio-activity has been reduced to less than 10 per cent of its initial intensity. If it is desirable to shorten this period because of infection, the initial dose of radon may be increased, the operative removal being done at the proper time to furnish an equivalent dose. Our experience has shown that surgical removal of the tumor may take place from three to five days after implantation of radon (Case 4). Accordingly, a greater dose of radon is placed in the 3 cm. sphere, amounting to between 27 and 32 millicuries, and in the 4 cm. sphere between 39 and 48 millicuries for from eight to ten skin erythema doses. In this procedure 60 per cent of the radium is used within five days and 40 per cent is wasted in the removed gold seeds.

The implantation of radon in gold seeds aims for a uniform distribution throughout the growth. If the origin of an early growth has been determined, the intensity may be increased in that region, otherwise uniformity produces the best results. The total number of millicuries of radon is divided into gold seeds of strength between 2.0 and 3.5 millicuries. An average of twelve to fifteen gold seeds is used and, therefore, some individual scheme of implantation must be in mind beforehand. Exposure must be adequate and the foramen, whether made surgically or by extraction or by extension of the disease, must be sufficiently accessible to permit the entrance of trocars for introducing the seeds from

Fig. 8. Case 3. Patient after treatment, showing very little facial asymmetry. The type of denture shown on the side is adapted to such a case.

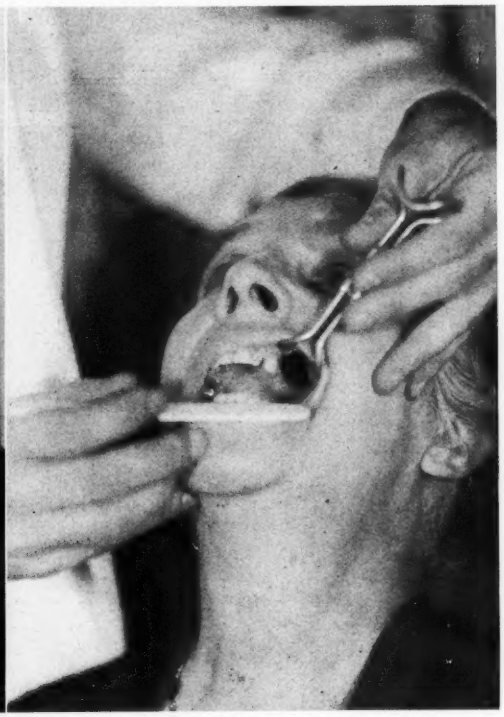

Fig. 9. Case 3. Intra-oral view of the wide aperture in the floor of the antrum.

all angles. The majority of seeds may be placed accurately with straight trocars, but it is well to have a few curved ones at hand, particularly when the foramen is in the anterior wall or through an alveolus.

In rare instances in which the growth has invaded the infra-orbital plate and soft tissues of the orbit, it is essential to implant gold seeds uniformly over the floor of the orbit. This may be readily accomplished with novocain infiltration at the same time the gold seeds are placed in the antrum. Such circumstances are demonstrated in Case 2, where the dose was calculated for a 4 cm. sphere.

Surgical Removal of Bulk of Tumor.—At the end of the prescribed time interval for the interstitial radiation, surgical intervention is necessary to provide free drainage and a wide permanent opening for observation. A chloroform anesthesia is desirable, particularly when an exploration is necessary, although nerve-block anesthesia is frequently satisfactory. The floor of the antrum is outlined on the hard palate and alveolar ridge, with the actual cautery. The cheek opposite this area should also be cauterized thoroughly close to the anterior wall in order to prevent surface bleeding. The segment of hard palate and alveolar ridge may then be removed in a relatively dry field. The bulk of friable tumor tissue may be curetted out and the cavity packed tightly for hemostasis. Daily irrigations may be carried on subsequently. The antrum becomes an integral part of the oral cavity.

When the growth invades the floor of the orbit and possibly the soft tissues of the orbit, exenteration of the orbital contents should be performed at the same time as the antrotomy. The anterior two-thirds of the orbital plate may easily be removed, permitting free drainage and the best possible exposure, with the external wall of the maxilla maintaining some degree of facial uniformity.

Fig. 10. Case 10. The facial deformity, with swelling and redness of the left cheek, as it existed before treatment.

TREATMENT OF RECURRENCES AND CERVICAL METASTASES

Post-operative irradiation is rarely advisable as a routine measure. Only in instances in which the growth invades the ethmoid area is it necessary to remove the bulk of tumor tissue to permit greater accuracy in placing the gold seeds and to establish drainage of this area, which would otherwise be impossible.

If a recurrence does appear, it is well to irradiate the whole cavity again with a dose calculated to deliver between 800 and 1,000 per cent skin erythema dose. The monel metal sphere is the most advantageous applicator for this purpose (Case 3). This applicator has a filter of 1.5 mm. of monel metal, or the equivalent of 0.5 mm. of platinum. The 5 mm. monel metal sphere may be packed into the antrum, as nearly as possible equidistant from the walls. Gold seeds may be used for a part of the total dose in cases in which there is sufficient tumor tissue to hold the implants. A second radiation adds greatly to the intensity of the reaction and prolongs the discomfort, with a delay in healing of from two to four months. Therefore, it is very desirable to deliver a lethal dose accurately and to terminate the disease with the first treatment.

Secondary extensions of disease into the cervical lymph nodes occur late in the course of carcinoma in the antrum. In cases in which the primary growth is far advanced and palliative treatment only is justifiable, then both the primary tumor and the metastasis are treated in this manner, regardless of the possible operability of the latter. This consists of periodic irradiation with short wave length X-rays or with the heavily filtered radium element pack.

If cervical involvement is present on admission and the primary growth is within accessible limits as shown in the accompanying case reports, the drainage area is given one high voltage cycle of X-radiation, supplemented by 16,000 milligram-hours with the element pack. This is given while the primary growth is under active treatment, and temporary control of the metastases may be expected from this amount of radia-

tion until the proper care has been taken of the primary lesion.

If the cervical node is freely movable and has not perforated the capsule, or has not become fixed to the deep vessels, it is considered operable and after external radiation a unilateral neck dissection is done under local anesthesia. If, on the other hand, the node is not movable, radon in gold seeds is implanted into it. The dose of this interstitial irradiation is calculated from the size of the mass found at operation—for from eight to ten skin erythema doses. Quick (29) has recently illustrated this method in a detailed discussion of the treatment of lymphatic metastases.

APPLICATION OF DENTURE

Some thought is wisely given to the present means of caring for the antral foramen after the actual treatment has been completed. Closure by a mechanical appliance or by plastic surgery is essential to normal life. In the type of patients under discussion the former method is desired primarily because of the exposure necessary in the long period of observation. Under the most favorable circumstances dentures are fitted with difficulty in edentulous mouths. The surgeon performing the radical antrotomy will not sacrifice adjoining bony structures needlessly if he is aware of the technical application of dentures. Of course, in cases in which two or more teeth remain the problem is simplified. However, it is always well to preserve as much of the alveolar process as possible. In the edentulous mouth the best denture is equipped with a hook-shaped projection, which rests on a portion of the antral surface of the hard palate. This is most effectively used in cases in which the anterior portion of the floor of the antrum can be saved. The hook-shaped projection, however, may be used medially or posteriorly from the aperture. Considerations of these difficulties ordinarily permit an ingenious dentist to fit a comfortable and comparatively water-tight denture.

Ultimate closure following a radical antrotomy for chronically infected antra has been successful, as reported by Axhausen (1) and Dean (10). However, no attempts have been reported following carcinomatous involvement and it is not considered advisable to attempt this within a five-year period. A permanent aperture has much in its favor in this group of patients.

REPORT OF CASES

The cases discussed in this paper were selected from patients under treatment in the Head and Neck Service at Memorial Hospital. Six patients were chosen as representative of special features which each demonstrated in the technical treatment of carcinoma of the antrum.

An Advanced Carcinoma of the Antrum Treated in 1921 With Radon in Bare Tubes

Case 1. P. S., a man 58 years old, entered Memorial Hospital in December, 1921.

History.—About one year previously a small growth was noticed on the hard palate. During the interval intermittent pains occurred in the teeth of the upper jaw. The growth gradually enlarged, with a bulging downward of the hard palate. A few weeks previously the pain in the teeth increased and temporary control of the metastases Since this time the ulceration and swelling had increased rapidly. There was no discharge from the nose.

Examination.—The man appeared to be in good general condition, with a slight swelling of the right cheek. The intra-oral examination showed an edentulous mouth, with a bulky, ulcerating mass 4.0 × 3.0 ×

2.0 cm. occupying the middle half of the right upper jaw and hard palate. This was apparently continuous with a primary growth which filled the right antrum. The nasal cavity was negative and there were no definitely palpable cervical nodes.

Clinical Diagnosis.—Carcinoma of the antrum, with invasion of the anterior wall and fungation through the hard palate.

Histologic Diagnosis.—Tissue from fungating growth was reported as squamous carcinoma (Fig. 1).

Treatment and Interval Observation.—Treatment was planned for interstitial irradiation with glass tubes. This was before the introduction of filtered implants. Accordingly, on December 1, 1921, 19.1 millicuries of radon in glass tubes were implanted in the antrum. Accurate placement was possible with trocars without further exposure, as a portion of the hard palate had been completely destroyed by the growth. A severe radium reaction followed ten days later. Progress was satisfactory but very slow, and the patient complained of a great deal more pain than the physical condition seemed to warrant. Large quantities of slough formed and sequestration of the antral walls was slow. It was not until four months after the initial treatment that a large sequestrum was removed from the maxilla, followed by symptomatic relief. A few months later a denture was fitted, with a projection extending into the antrum and protruding forward to serve as a hook for holding the denture in place (Figs. 2, 3). The patient has remained free from disease for nine years and the denture has been entirely satisfactory throughout this period.

Comment.—This patient is presented to demonstrate the early type of treatment for an advanced carcinoma of the antrum, with infiltration of the anterior wall and hard palate. Bare tubes were the only form of interstitial irradiation in use at that time. In comparison with the gold-filtered seeds in present use, the unfiltered bare tubes give approximately 50 per cent greater dosage per millicurie (Table I). Similarly the intensity of the local reaction is much greater, due to the activity of the soft (β) radium rays. The calculated dose for an infiltrating carcinoma has shown that a minimum of 1,000 per cent erythema dose was delivered to all parts of this growth. The exposure was adequate, the ulcerated palate easily permitting the entrance of the trocars bearing the tubes. Much of the intense and prolonged suffering may be relieved by the removal of the bulk of tumor within a two-week period following the implantation of the seeds. This is now done as a routine measure to facilitate drainage and furnish the maximum exposure.

TABLE I.—INTERSTITIAL IRRADIATION WITH BARE TUBES FOR ADVANCED CARCINOMA OF ANTRUM (CASE 1)

	Source of radiation				Location	Minimum dose to tumor
	Interstitial					
Date 12-2-21	Method of application	Filter	Number of millicuries	Time	Right antrum	1,000
	Bare tubes	Glass	19.1	Permanent		
	Total tissue dose (in percentage of skin erythema)					1,000

Note.—Tissue dose calculated for a sphere 4 cm. in diameter.
Bare tubes deliver approximately 50 per cent greater dose than gold seeds.

The difficulties of caring for the permanent aperture in an edentulous mouth were successfully overcome with this patient. An ingenious dentist with expert mechanical abilities can invariably produce a comfortable and satisfactory denture for any type of aperture. This will be further demonstrated in the subsequent case reports.

An Advanced Carcinoma of the Antrum, with Carcinomatous Infiltration of the Soft Tissues of the Orbit, was Treated in 1923 with Radon in Bare Tubes; Irradiation was Followed by Exenteration of the Contents of the Antrum and Orbit

Case 2. H. H., a man 55 years old, entered Memorial Hospital in March, 1923.

History.—In October, 1922, the patient received a blow over the left maxilla. An indurated, painless swelling of the cheek appeared; the following month this was removed intra-orally and treated with radium without the antrum being entered. The details of the treatment are not known. The patient was relatively free from symptoms until two weeks previous to his admission, when the left cheek again became swollen. Severe pain in the region of the antrum accompanied the return of the tumor.

Examination.—The man appeared to be in good general condition, save for a marked swelling and redness of the left face, and edema of the lids which completely closed the eye. The conjunctivæ were injected. The eye appeared normal and function compared roughly with that of the opposite eye. The hard palate showed no deformity. There was a small sinus tract extending through the bicuspid alveolus into the antrum. The nasal passage was normal and there was no definite evidence of disease in the neck.

Pathology.—Squamous carcinoma (Fig. 4).

Roentgen Examination.—The roentgenologist's findings were as follows: "The left antrum is cloudy, due to thickened membrane and thickening of the floor of the orbit. The floor of the antrum and adjacent portion of the superior maxilla are irregular. The appearance is that of carcinoma of the antrum."

Treatment and Interval Observation.—Thorough radiation was planned for the antrum and orbit, followed by the removal of the contents of both cavities, with the establishment of permanent openings in the floors of the orbit and antrum.

March 21-23, 1923, a dose of 10,000 milligram-hours was given with the emanation pack, at 6 cm., over the left antrum. The external carotid vessels were exposed, and ligated. As a preventive measure, 12 mc. of radon in bare tubes were implanted in the drainage areas at that time. April 6, 68.4 mc. of radon in 0.5 mm. platinum needles were placed on the floor of the orbit for five hours. April 26, under chloroform anesthesia, a portion of the hard palate and alveolar ridge 3 cm. in diameter was outlined with the actual cautery, and this segment was removed with mallet and chisel. The antrum contained pus and a small amount of tumor tissue was found in the upper half, which was curetted out and the cavity packed tightly. The contents of the orbit, including the eyelids, were removed with the cautery, together with the anterior half of the floor of the orbit. Daily irrigations were started on the second day. On the tenth post-operative day 43.7 mc. of radon in bare tubes were scattered in the tip of a finger cot stuffed with cotton and this was placed in the antrum. The finger cot remained in place twenty-four hours. The local radiation reaction was intense and sequestra from the walls of the antrum were removed at intervals for three months.

Dr. Shepard, in the Dental Department, fitted the patient with a denture which he has worn without inconvenience for over seven years (Fig. 5). The man is at present

TABLE II.—TISSUE DOSE RECEIVED FOR RELATIVELY EARLY CARCINOMA OF ANTRUM (CASE 2)

Date	Source of radiation				Location	Dose to skin	Minimum dose to tumor
	External "radium element pack"				Left antrum	100	50
	Milligrams of radium	Filter	Distance from skin (cm.)	Milligram-hours			
3-21-23	4,000	1.5 mm. brass 0.35 mm. platinum	6	10,000			
	Tissue dose from external sources						50
	Interstitial						
	Method of application	Filter	Number of millicuries	Time in hours	Floor of orbit		150
4-6-23	Needles	0.5 mm. platinum	68.4	5			
4-16-23	Bare tubes	Glass	43.7	24	Left antrum		600
	Tissue dose from internal sources						750
Total tissue dose (in percentage skin erythema)							800

Note.—Tissue dose calculated for sphere 3 cm. in diameter.
Bare tubes deliver approximately 50 per cent greater dose than gold seeds.

free from disease seven years and nine months after the initial treatment (Fig. 6).

Comment.—This patient demonstrates a growth arising in the region of the ethmoid sinus and floor of the orbit, with infiltration of the tissues of the orbit. Treatment was planned for external irradiation followed by interstitial irradiation in the orbit and antrum. The growth was confined in close proximity to the floor of the orbit and the dose was calculated for a 3 cm. sphere. The relative efficiency of the external and interstitial sources of radiation is well shown in Table II, where it is seen that external radiation delivered only 6 per cent of the total tissue dose. The total amount delivered to the tumor was 800 per cent S.E.D., which was a lethal dose for this growth. The irradiation was followed by the surgical removal of the contents of the orbit and antrum, and a permanent drainage into the mouth was established. The post-radiation discomfort was thereby considerably shortened. Maintenance of the anterior wall of the maxilla preserved the contour of the face and made possible the application of a satisfactory and comfortable denture (Fig. 5).

An Advanced Carcinoma of the Antrum Demonstrating Sublethal and Minimum Lethal Tissue Doses

Case 3. A. S. H., a woman 58 years old, entered Memorial Hospital in November, 1926.

History.—About one year previously a chronic nasal catarrh appeared, and about

this time the bicuspid and first molar teeth began to cause some trouble. The two teeth were removed and a bridge was fitted. A few months later the woman began to have severe pain in the left cheek, with radiations up the left side of the head. After many consultations the patient was finally referred to the hospital for a growth presenting in the left nasal passage. No history of epistaxis.

Examination.—The woman appeared in good general condition with normal facial symmetry. The left nostril was occluded by a friable tumor mass which bled readily upon being touched. The growth was attached to and perforated the mesial antral wall posterior to and above the foramen. The septum appeared normal. Intra-oral examination showed no deformities and there was no definite evidence of metastases in the neck.

Roentgen Examination.—The findings of the roentgenologist were as follows: "There is bone destruction of the mesial wall of the

TABLE III.—SUBLETHAL AND LETHAL TISSUE DOSES FOR CARCINOMA OF ANTRUM (CASE 3)

Date	Source of radiation				Location	Dose to skin	Minimum dose to tumor
	External X-ray						
	Voltage	Filter	Distance from skin (cm.)	Milliampere-minutes			
11-17-26	195	0.75 mm. Cu	50	320	Left antrum	100	75
11-19-26	195	0.75 mm. Cu	50	360			
	Tissue dose from external sources						75
	Interstitial						
	Method of application	Filter	Number of millicuries	Time	Left antrum medial wall		610
11-15-26	Gold seeds	0.3 mm. Au	12.25	Permanent			
	Tissue dose from internal sources						610
1926	Total tissue dose (in percentage skin erythema)						685
	Interstitial						
	Method of application	Filter	Number of millicuries	Time in hours	Left antrum		400
10-17-29	Gold seeds	0.3 mm. Au	11.6	Permanent			550
11-22-29	Monel ball	1.5 mm. monel metal	99	22			
	Tissue dose from internal sources						950
1929	Total tissue dose (in percentage skin erythema)						950

Note.—In 1926 tissue dose calculation for 3 cm. lesion.
In 1929 tissue dose calculation for 4 cm. lesion.

antrum, although the antral cavity is not occluded. The appearance is suggestive of carcinoma."

Pathology.—Adenoid cystic epithelioma (Fig. 7).

Fig. 11. Case 4. Photomicrograph of tissue from fungating growth in tooth socket showing epidermoid carcinoma, Grade III, radiosensitive.

Treatment and Interval Observation.—Treatment was outlined for a relatively early growth arising in the antrum and invading the medial wall, with perforation into the nose. Two high voltage X-ray treatments were given November 17–19, 1926, which were equivalent to one erythema dose on the skin. Approximately at the same time 12.25 millicuries of radon in gold seeds were implanted in the growth occupying the medial half of the antrum and representing the region of the middle turbinate. An intense radiation reaction followed, with complete regression so far as could be determined.

Three years later, in the Summer of 1929, a nasal discharge reappeared, accompanied by an aching pain in the antrum, associated with slight exophthalmos, conjunctivitis, and lacrimation. Stereoscopic X-ray films of the sinuses revealed some alteration of density in the left antrum, without gross bone destruction. October 17, 1929, 11.6 millicuries of radon in gold seeds were implanted in a recurrence in the upper inner portion of the antrum. Approximately one month later a portion of the anterior wall of the antrum was removed, under local anesthesia, for drainage and exploration. The antrum contained thick pus and the mucous membrane

was thickened. A mass of tumor tissue about 1.0 cm. in diameter was found in the upper inner angle of the antrum. The cavity was packed. One week later the monel metal sphere was inserted in the antrum, not at its central point but more toward the inner, posterior, superior angle, and held in place with albolene gauze. The reaction which followed was very severe, with aching pain and an increase in the inflammatory reaction in the orbit. The symptoms subsided temporarily after the radiation activity had terminated. Several sequestra were removed at intervals during the next three months, but the inflammation in the orbit persisted, with a gradual increase of exophthalmos and with diplopia.

In March, 1930, there was no symptomatic relief and it was decided, therefore, to enlarge the aperture into the antrum. Stereoscopic views of the accessory nasal sinuses revealed evidence of a destructive process involving the floor and the medial wall, suggesting carcinoma of the antrum. Under chloroform anesthesia the posterior half of the alveolar process, including three teeth, was removed. A quantity of necrotic bone was found on the floor of the antrum. The floor of the orbit seemed sound. The inner wall, of course, opened into the nasal passage. All of the necrotic bone and slough were removed and the cavity was packed. Daily irrigations were started immediately and there has been a slow but definite relief from pain, and the right eye has gradually returned to normal function and appearance (Fig. 9). Now (November 6, 1930), there is an opening in the floor of the antrum 3.0×2.0 cm. (Fig. 10). The granulating surfaces have epithelized completely and the patient is symptomatically and clinically free of disease.

A temporary denture was fitted several weeks after the last treatment, periodic adjustments being necessary due to the contracting scar. A permanent denture has now been applied, with attachments to several teeth (Fig. 8).

Comment.—The exact site of origin of this growth has not been demonstrated definitely, although the bulk of clinical evidence supports the antral surface of the medial wall, with subsequent infiltration into the nose.

At the time of the treatment in 1926, the growth was considered to be confined closely to the medial wall of the antrum, without filling the antral cavity. The irradiation delivered to the antrum was approximately 700 per cent S. E. D., which is now considered a sublethal dose (Table III). This case also illustrates the danger of treating only a part of the antrum, even though it may not be involved throughout.

A recurrence appeared approximately three years later and was treated on the basis of an advanced growth, with infiltration of two walls. In the lower half of Table III, the calculations for a 4 cm. sphere show that 950 per cent S.E.D. was delivered to the tumor-bearing area.

The clinical course following the second treatment demonstrates that a foramen in the anterior wall is not as a rule sufficient for drainage. However, the records show that occasionally this has proven to be adequate. The incomplete drainage caused severe and prolonged suffering, particularly as this patient was given a second course of radiation therapy, which in such cases is always more severe.

Although it is only a year since the last treatment, the general appearance of the cavity and the excellent regenerative qualities of the lining mucous membrane support a favorable prognosis (Fig. 9).

An Advanced Carcinoma of the Antrum was Treated in a Foreshortened Time Interval in Order to Control Virulent Infection

Case 4. M. B., a man 65 years old, entered Memorial Hospital in June, 1928.

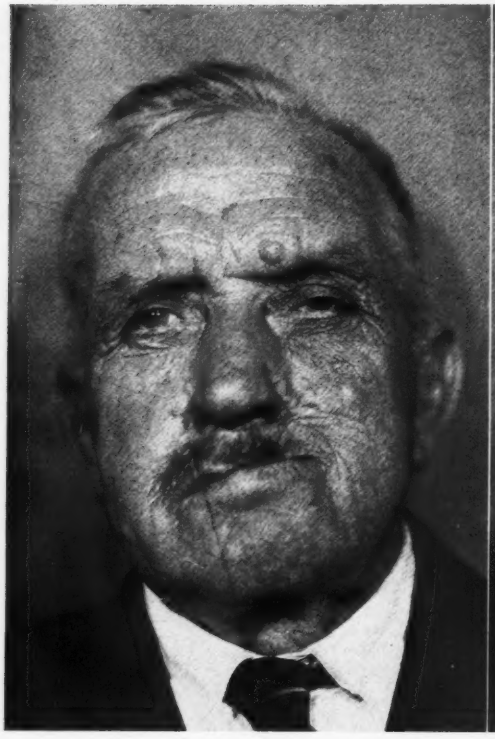

Fig. 12. Case 4. This photograph shows the loss of facial symmetry due to the destruction of the anterior wall of the antrum during treatment.

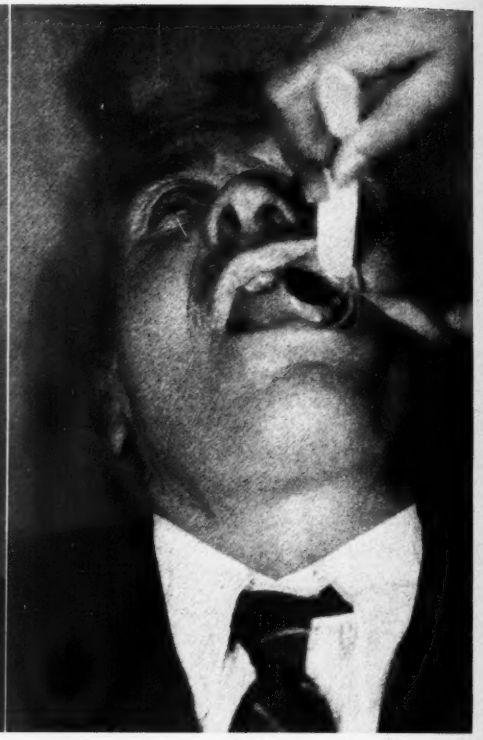

Fig. 13. Case 4. Intra-oral view of aperture in the floor of the antrum. The alveolar process is shown, anterior and posterior to the foramen.

History.—Four weeks previously the left cheek became swollen and inflamed without pain, although an upper tooth on that side had given the man some discomfort. Thinking that the pain was due to bad teeth, the patient had several extracted from the upper jaw. The swelling increased and he was admitted to a hospital, where punctures were made in the upper gum and hot fomentations were applied without relief to the patient. A previous catarrhal condition of the nose or throat was denied.

Examination.—The man appeared in good general condition save for marked swelling and redness of the left cheek (Fig. 10). This was due to a low grade cellulitis covering an area of the cheek 5 cm. in diameter; the center over the maxilla was fluctuant. On intra-oral examination, friable tumor tissue presented through one of the tooth sockets and also on the anterior surface of the left upper alveolar process, with an ulcerated mass 1 cm. in diameter. The hard palate was normal; the nasal cavity was negative; there was no cervical adenopathy.

Roentgen Examination.—The roentgenologist reported his findings as follows: "Thickened membrane, granulations, and pus in the left antrum. The dense clouding of this antrum, along with the loss of normal bone density of the outer wall, suggests infiltration here, and may be taken as roentgen-ray evidence corroborating the clinical diagnosis of carcinoma of the antrum."

Pathology.—Tissue from the ulcerated area was reported as "epidermoid carcinoma, Grade III, radiosensitive" (Fig. 11).

Treatment and Interval Observation.—Treatment was planned for an advanced inoperable carcinoma of the antrum; the radiation was based, therefore, upon a sphere 4 cm. in diameter (Table IV). Within four days (June 13-17, 1928), 16,000 milligram-hours were given with the element pack at a 6-cm. skin distance over the left antrum. On June 20, 36 millicuries of radon in fifteen gold seeds were implanted in the antrum. The open tooth socket and the fungation through the alveolus were adequate entries for the trocars carrying the gold seeds. The seeds were placed uniformly throughout the tumor tissue. Five days later (June 25), under chloroform anesthesia, an opening 2.5 cm. in diameter was made by removing a portion of the hard palate and adjoining alveolar ridge with the actual cautery and chisel. The contents of the antrum, consisting of friable tumor tissue and pus, were removed by curettage and the cavity was packed tightly with iodoform gauze. Daily irrigations and packing were started on the second post-operative day. There was an acute radiation reaction within the antral cavity and over the skin of the cheek. The patient was discharged to the Out-patient Clinic on the twelfth post-operative day. One month later the packing was left out entirely and he was instructed to irrigate the cavity himself, as the surfaces were partly covered by granulation tissue, although the mucous membrane of the antrum had shown no evidence of regeneration. No recurrences or metastases have been noted to the present time and the cavity is now entirely covered by normal mucous membrane (Figs. 12, 13). Dr. Engel, in the Dental Department, fitted a denture with a mold appliance which filled the palate defect effectively. The patient has remained free of disease two years and five months.

Comment.—An advanced carcinoma, with infiltration of the anterior wall and floor of the antrum and with fungation through the alveolar process and tooth socket, has been treated successfully to date by irradiation combined with surgical exposure and drainage.

Treatment was based on the calculation for an infiltrating growth and the time interval of interstitial treatment was foreshortened because of severe infection (Table IV). An abnormally large amount of radon was necessary and, therefore, a so-called overdose of 36 mc. was implanted. An equivalent of 22 mc. was effective and 14 mc. were wasted for the time advantage. The entire treatment covered a period of two weeks and a tissue dose of over 800 per cent S.E.D. was delivered to the growth.

An Advanced Carcinoma of the Antrum Demonstrating an Immediate Method of Histologic Diagnosis by Aspiration and Smear

Case 5. C. R., a man of 61 years, was admitted to Memorial Hospital in December, 1929.

History.—Four months previously a dull pain started in the right antrum. A month later the cheek became swollen and the eye began to tear intermittently. The cheek slowly enlarged and on October 10 his dentist extracted the right upper first and second molar teeth and incised a swelling lateral to the alveolar ridge, but found no pus. On November 25, a portion of the anterior wall of the antrum was removed for drainage. The diagnosis was made at this time and the patient was referred to this Hospital for treatment.

Examination.—A well developed and well nourished man appeared, with redness and swelling of the right face. There was slight exophthalmos of the right eye, with excessive tearing. Intra-orally there was a

Fig. 14. Case 5. Intra-oral view showing a widening of the alveolar process and a swelling in the buccogingival groove (before treatment).

bulging of the mucous membrane lateral to the superior alveolar process, which was the cause for the fullness of the right cheek seen externally (Fig. 14). This mass was 3 cm. in diameter and obviously arose in the antrum, protruding through the previously opened anterior wall. There was no visible evidence of the previous operation on the anterior wall. Examination of the right naris disclosed a granular mass in place of the inferior turbinate. There was no adenopathy.

Roentgen Examination.—The findings were: "Stereoscopic views of the sinuses reveal thickened granulations or pus in the left antrum. Ethmoids are clear and frontals are absent. The right antrum is cloudy and extensive destruction of its floor is noted. The appearance corroborates the clinical diagnosis of carcinoma of the right antrum."

Pathology.—Biopsy from tissue in the nasal passage proved it to be inflammatory. An aspiration was, therefore, performed through the cheek and a smear of tissue obtained in this manner was reported to be "Schneiderian carcinoma" (Fig. 15). The operative specimen removed later confirmed this diagnosis: "Schneiderian carcinoma, Grade III, relatively radiosensitive, with marked infection" (Fig. 16).

Treatment and Interval Observation.—Treatment was outlined for an advanced growth infiltrating both the anterior wall and floor of the antrum, as shown in Table V. On December 11, 1929, 16,000 milligram-hours were given at 6 cm. over the antrum. A foramen had already been made through the anterior wall. December 13, 39.0 millicuries of radon in gold seeds were implanted in the antrum. The curved trocars were of great assistance in depositing the seeds accurately. Seven days later, December 20, under chloroform anesthesia, the right upper alveolar process and the lateral half of the right hard palate were outlined with the actual cautery. The bone was removed with mallet and chisel and the bulk of the contents in the antrum were removed with curette. Moderate infiltration of the growth was noted in the cheek and this area was removed with the cautery. The cavity was packed with iodoform gauze.

An acute radiation reaction followed immediately, with the formation of quantities of slough. In July, 1930, the removal of necrotic tissue started arterial hemorrhage, which required a ligation of the external carotid artery and its branches.

At the last examination (November 1, 1930), there was no evidence of recurrence; epithelization of the raw surfaces had started, and the patient was free from symptoms (Figs. 17, 18).

Comment.—Clinically and roentgenologically this patient was considered to have an advanced carcinoma of the antrum, with invasion of the floor and anterior wall. The inflammatory reaction was marked in the

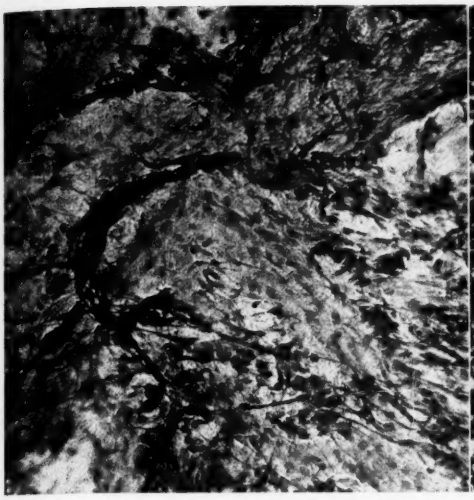

Fig. 15. Case 5. Photomicrograph of a smear of tissue obtained by aspiration through the cheek and anterior wall of the antrum, showing Schneiderian carcinoma.

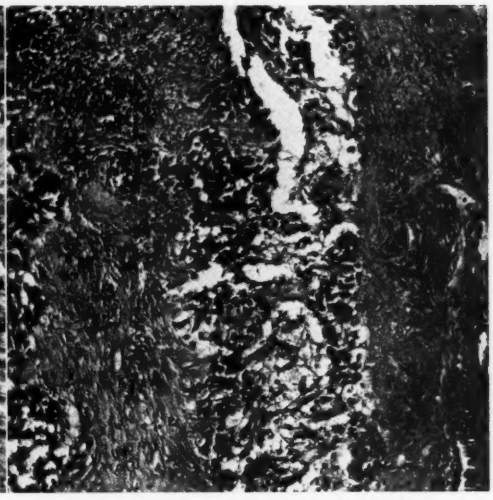

Fig. 16. Case 5. Photomicrograph of tissue removed later at antrotomy, confirming the aspiration diagnosis of Schneiderian carcinoma, Grade III, relatively radiosensitive, with morbid infection.

tissues of the cheek and infection had already extended into the orbit; therefore, the time interval for treatment was limited. An immediate histologic diagnosis was obtained by the aspiration and smear method, whereas the regular biopsy not only would have taken five days, but would have broken the mucous membrane over the tumor and would have introduced further infection. The entire treatment with external and interstitial irradiation was complete in nine days, as shown in Table V. An overdose of radon totalling 39.0 mc. in gold seeds was implanted for a measured time interval of seven days. During this period 28 mc. were effective—the remaining 11 mc. were wasted. On the ninth day after treatment was started, the bulk of the growth was removed. The tissue dose from the combined irradiation totalled 1,000 per cent skin erythema dose. An unusually acute radiation reaction followed and an arterial hemorrhage occurred which could not be controlled by packing, therefore, ligation of the external car tid artery and branches was necessary. This procedure has rarely been required since the advent of filtered implants.

An Advanced Carcinoma of the Antrum Demonstrating the Treatment of the Primary Growth and Cervical Metastases

Case 6. C. L., a man 32 years of age, was admitted to Memorial Hospital in July, 1927.

History.—Four months previously the patient had begun having a severe pain in the upper right jaw, with a persistant aching of two teeth. A swelling in an alveolus of a previously extracted tooth appeared, was opened, and there was temporary relief from pain. Two months later a profuse nasal discharge started, followed by a gradual swelling of the right cheek. An operation was performed on the right upper alveolar process, and the patient was referred to this

TABLE IV.—TISSUE DOSE RECEIVED FOR ADVANCED CARCINOMA OF ANTRUM (CASE 4)

Date	Source of radiation				Location	Dose to skin	Minimum dose to tumor
6-13-17 1928	External "radium element pack"				Left antrum	130	55
	Milligrams of radium	Filter	Distance from skin (cm.)	Milligram-hours			
	4,000	1.50 mm. brass 0.35 mm. platinum	6	16,000			
	Tissue dose from external sources						55
6-20-28	Interstitial				Left antrum		760
	Method of application	Filter	Number of millicuries	Time			
	Gold seeds	0.3 mm. Au	36	5 days			
	Tissue dose from internal sources						760
Total tissue dose (in percentage skin erythema)							815

Note.—Tissue dose calculation for a sphere 4 cm. in diameter.

Hospital with a diagnosis of carcinoma of the antrum. The man was a deaf-mute as a result of scarlet fever and diphtheria in childhood.

Examination.—The patient was a well developed young man, with an asymmetry of the face due to a swelling of the right cheek (Fig. 19). There was an indurated mass in the cheek, slightly movable over the maxilla. The right antrum opened into the mouth by a long fissure along the external surface of the alveolar ridge. The anterior wall of the antrum had been removed, and the aperture was filled with necrotic tissue. The hard palate appeared normal; the nasal passages were clear; there were two enlarged, hard nodes 2 cm. in diameter located in the posterior portion of the right submaxillary triangle, both of which were freely movable.

Roentgen Examination.—The roentgenologist's findings were as follows: "The left antrum, left ethmoids, and frontals are clear. The right frontal is slightly cloudy. The right ethmoid is comparatively clear, but the right antrum is cloudy and somewhat deformed. Its outer wall is absent. The superior maxilla beneath is comparatively free of involvement, as are its inner wall and roof or floor of the orbit."

Pathology.—Tissue from the antrum was reported as "squamous carcinoma, Grade I" (Fig. 20). The cervical nodes removed later showed "squamous carcinoma in lymph nodes, capsule intact, marked but not complete radiation regression" (Fig. 21).

Treatment and Interval Observation.—Treatment for the primary tumor was estimated for an advanced growth, with invasion, and the metastases were to be controlled by external radiation until the former was cared for. On July 7, 1927, the radium

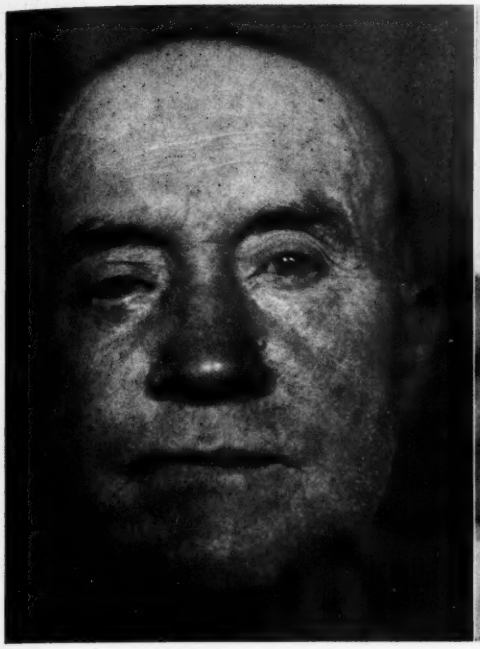

Fig. 17. Case 5. Recent photograph of the patient, since the completion of treatment, showing the morbid fibrosis of the tissues of the cheek from external and interstitial irradiation.

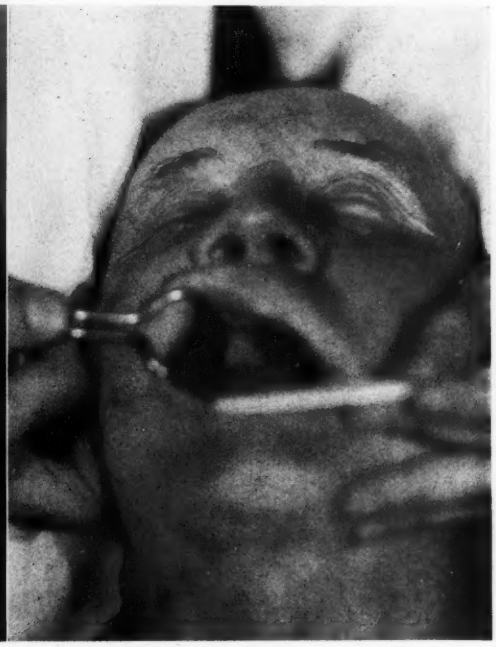

Fig. 18. Case 5. Intra-oral view of the aperture in the floor of the antrum.

tray was placed over the maxilla for 2,500 milligram-hours. This applicator has a filter of 2.0 mm. brass and a skin distance of 3 centimeters. The following week 18,000 milligram-hours with the radium element pack were given over the right submaxillary triangle at 6 cm. skin distance. During this period, on July 15, 1927, 24.5 mc. of radon in gold seeds were implanted into the antrum. A future exposure was not necessary, as the seeds were easily placed through the foramen already present in the anterior wall. A marked radium reaction followed in the antrum and neck. The patient attended the daily clinic for irrigations, and slough was removed for several weeks. Two months later the skin appeared normal again; the nodes had not changed and were still freely movable. September 29, 1927, a complete neck dissection was done, with the removal of the sterno-cleido-mastoid muscle, internal jugular vein, the deep cervical chain of nodes, the submaxillary gland and surrounding tissues up to the mastoid process. The wound healed by primary union. The patient was apparently free from disease for exactly one year, when a movable 2.5 cm. mass was found at the tip of the mastoid process. One high voltage X-ray treatment (9-18-28, five minutes, 30 ma., filter 0.5 mm. Cu plus 2.5 mm. Al, voltage 175, focal distance 30 cm.) was given over the mass. Two days later the patient was admitted to the hospital. The mass was exposed under novocaine anesthesia and 14.56 mc. of radon in gold seeds were implanted into it. Regression followed rapidly. On Nov. 18, 1930, the patient was in good general condition and there was no evidence of disease in the antrum or neck (Figs. 22, 23).

Fig. 19. Case 6. The appearance of the patient on admission, showing marked swelling of the right cheek. The anterior wall of the antrum had previously been removed and the swelling here shown was due to carcinomatous infiltration of the tissues of the cheek.

This patient has never needed an appliance to close the opening. He learned quickly that, if he could control his cheek muscles sufficiently to keep the cheek tightly over the surface of the maxilla, he could prevent entrance of liquids, etc., from the mouth.

Comment.—The primary antral growth was treated as an advanced carcinoma and received 850 per cent S.E.D. with the combined external and interstitial irradiation as shown on Table VI. Cervical metastases were present on admission and were held in check for two months by external irradiation with the radium element pack. At that time the primary growth had reacted satisfactorily to treatment and as the nodes were still freely movable a radical dissection of the neck was performed.

One year later a recurrence appeared near the tip of the mastoid process. One high voltage treatment was given over the mass. Exposure was done and the maximum diameter was found to be 2.5 centimeters. A

TABLE V.—TISSUE DOSE RECEIVED FOR ADVANCED CARCINOMA OF ANTRUM (CASE 5)

Date	Source of radiation				Location	Dose to skin	Minimum dose to tumor
	External "radium element pack"						
	Milligrams of radium	Filter	Distance from skin (cm.)	Milligram-hours	Right antrum	130	55
12-11-29	4,000	1.50 mm. brass 0.35 mm. platinum	6	16,000			
	Tissue dose from external sources						55
	Interstitial						
	Method of application	Filter	Number of millicuries	Time	Right antrum		960
12-13-29	Gold seeds	0.3 mm. Au	39.0	7 days			
	Tissue dose from internal sources						960
Total tissue dose (in percentage skin erythema)							1,015

Note.—Tissue dose calculation for sphere 4 cm. in diameter.

tissue dose of 900 per cent S.E.D. was implanted into it. The patient has been without evidence of disease to date. The facial deformity is most marked in this patient as a result of the complete removal of the anterior wall of the antrum previous to admission (Fig. 22). The upper portion of the outer wall of the maxilla is rarely involved and preservation of this prominence preserves the facial symmetry.

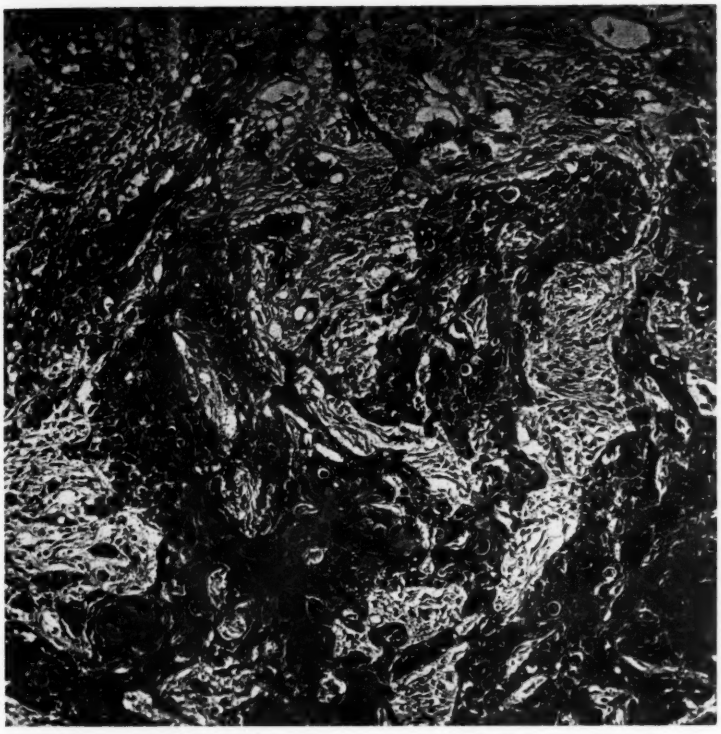

Fig. 20. Case 6. Photomicrograph of tissue from the antrum showing squamous carcinoma, Grade I.

PROGNOSIS

It is significant to note that, in a survey of patients well five years or more, the great majority were in the advanced infiltrative group. A procedure requiring radical exposure and thorough radiation, therefore, is responsible for the majority of the successful results. Heretofore early lesions which only partially filled the antrum were treated locally rather than on a calculated dose for the antrum as a whole. It is our experience in dealing with a definitely limited cavity, as the antrum, that it is advisable to treat it as a unit. Therefore, under the present principles of treatment at Memorial Hospital the only unfavorable cases from a curative standpoint are those with extension of the primary growth into the pterygomaxillary fossa or into the base of the skull, unless inoperable metastases restrict us to palliative measures only.

Time will undoubtedly show whether or not the management of carcinoma of the antrum as described above with an immediate

TABLE VI.—TISSUE DOSE RECEIVED FOR ADVANCED CARCINOMA OF ANTRUM (CASE 6)

Date	Source of radiation				Location	Dose to skin	Minimum dose to tumor
7-7-27	External radium tray				Right antrum	115	20
	Millicuries of radon	Filter	Distance from skin (cm.)	Milligram-hours			
	1,294	2.0 mm. brass	3	2,500			
	Tissue dose from external sources						20
7-15-27	Interstitial				Right antrum		840
	Method of application	Filter	Number of millicuries	Time			
	Gold Seels	0.3 mm. Au	24.5	Permanent			
	Tissue dose from internal sources						840
Total tissue dose (in percentage skin erythema)							860

Note.—Tissue dose calculated for sphere 4 cm. in diameter.

method of histologic diagnosis by aspiration, with the irradiation destruction of the growth by a calculated minimal lethal dose and with surgical exposure and drainage, is effective. Sufficient time has not elapsed to demonstrate five-year results. However, it is the impression of the Staff of the Head and Neck Service that the results are improving. This may be demonstrated later when such a report is made.

CONCLUSIONS

1. Carcinoma of the antrum is not recognized in its early stages.

2. A method of immediate histologic diagnosis by aspiration and smear is submitted, found to be suitable as a routine diagnostic procedure if fungation has not occurred.

3. Radium and X-radiation must be depended upon to deliver a lethal dose to the tumor.

4. The minimum lethal dose is standardized for carcinoma, with and without bone invasion of the antral walls.

5. Preliminary surgical exposure of the contents of the antrum must be sufficiently wide to permit the accurate and uniform placement of radon implants throughout the tumor-bearing area.

6. Carcinomatous involvement of the floor of the orbit requires the exenteration of the contents of the orbit in addition to an intra-oral antrotomy for an adequate approach to this type of growth extension.

7. The cautery removal of the bulk of tumor tissue shortens the convalescent period by providing free drainage. This procedure has assured in many patients a recovery which otherwise would have been doubtful.

8. Closure of the aperture in the floor of the antrum by mechanical means is effective and comfortable for the patient. Later plastic closure is probably ill advised in patients recovering from carcinoma of the antrum.

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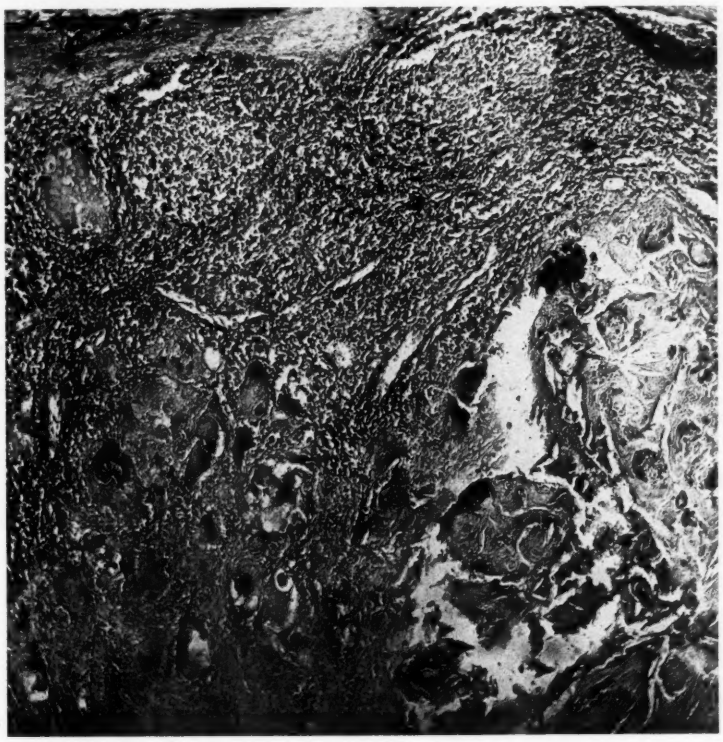

Fig. 21. Case 6. Photomicrograph of tissue from metastatic cervical node removed by radical neck dissection after thorough external radiation, showing squamous carcinoma in lymph node, capsule intact, with marked but not complete radiation regression.

Fig. 22. Case 6. Recent photograph of the patient (since treatment) showing marked facial deformity, due to the complete removal of the outer wall of the maxilla.

Fig. 23. Case 6. Intra-oral view showing the aperture in the anterior wall of the antrum; the floor is practically intact.

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DISCUSSION

DR. ROBERT R. NEWELL (San Francisco): I see several important things in what Dr. Sharp has told us about successful treatment of malignant disease in the maxillary antrum. He has used a courageous, sufficient dose of radiation, applied in a limited time interval. He realizes the necessity of using a dosage which gives a rather difficult convalescence. He expects and accepts the separation of bony sequestra after such a very heavy treatment. Apparently it is not possible to cure carcinomas in this region without such heavy dosage. We have the same experience in the uterine cervix, in which case we have a limited distribution of the disease, and we must give very heavy dosage to a comparatively limited area. If we do not get a very heavy dosage, we do not cure.

It seems to me that we must separate our patients into two classes: Those in whom we can hope for a real cure, and those in whom we cannot hope for a cure. In those that we propose to attempt to cure, we must be very courageous and expect a good deal of difficulty with our radiation reaction. It will not do merely to put in a little radium; the dosage that Dr. Sharp has been using is really tremendously heavy.

The second point is Dr. Sharp's insistence on adequate surgical drainage. That is as necessary a part of his treatment, as I see it, as the sufficient radiation dosage. You cannot supply such a dosage and permit the patient to go without a very wide open drainage into the mouth. Dr. Sharp cuts out a part of the palate and the alveolar process on that side. It would be a great comfort to me if I could persuade my rhinologist consultant always to do the same thing. There is nothing more discouraging to me than to see a case of malignancy in the antrum which has already been operated upon under the lip, yet with no opening into the mouth, only an opening into the canine fossa, and then to be asked to use radium treatment to clear up the malignancy that the surgeon knows remains behind. If, however, he has made an opening into the roof of the mouth as large as 3 centimeters, even though it has already been operated upon and there is no tumor to insert the radium needle or seeds into, then I think I can do a placement of the radium by making a cast or mold set up into the middle of the surgical defect and give a very heavy dosage, such as Dr. Sharp suggested.

CORRECTION FACTORS FOR BAROMETRIC PRESSURE AND TEMPERATURE AS APPLIED TO X-RAY MEASURING DEVICES CALIBRATED IN INTERNATIONAL ROENTGENS

By JOHN A. VICTOREEN, CLEVELAND, OHIO

DURING the past several years, measuring instruments, as used for X-ray treatments covering both superficial and deep therapy, have been a subject of intense interest in therapeutic fields. To evaluate properly present X-ray measuring instruments and to clarify the measurement of dosage in the international unit of X-ray measurement is the purpose of this article.

As the evolution of the modern X-ray machine has included many improvements tending toward increased constancy of output, the checking of constancy alone has become relatively unimportant as compared with the direct measurement of dose at the point of treatment in some inflexible unit. This unit must be capable of co-ordination with the variables encountered in treatment work and must be founded on physical principles that will permit of exact duplication from its definition. The international roentgen, as selected, measurement of which is based on the ionization of atmospheric air under prescribed conditions, met all these requirements. This international unit of quantity, as defined and adopted at the Stockholm Congress of Radiology in 1928, is as follows:

> The international unit of roentgen radiation is that quantity of X-ray radiation which, when the secondary electrons are fully utilized and the wall effect of the chamber is avoided, produces in 1 c.c. of atmospheric air at 0° C. and 760 mm. mercury pressure such a degree of conductivity that one electrostatic unit of charge is measured at saturation current.

The unit itself is named the "roentgen" and is designated by the small letter "r," intensities being measured at point of application in r per minute.

To appreciate modern advancement properly, it would be well to consider dosimetry briefly as it was before its present standardization. The application of roentgen rays as a therapeutic agent has been handicapped until recently by the lack of practical methods of measurement. Although various types of measuring instruments were developed, none was entirely satisfactory, each having some particular disadvantage which made it impractical for clinical purposes. The earlier instruments were calibrated in arbitrary units set up by the individual physicist or roentgenologist, there being no standard dosage unit upon which all could agree. Strictly speaking, these instruments were not dosage instruments, and they served the purpose of checking the X-ray output only in so far as constancy was concerned. A representative example of this type was that of a large chamber placed in the filter holder of the X-ray tube, connected to a galvanometer and a suitable source of current. A constant current reading indicated a constant X-ray intensity. Such apparatus was not suitable for the measurement of dosage at the point of irradiation and could not, therefore, be used to interpret dosage in terms of an international unit.

In considering X-ray measurement, it is not sufficient that the patient be protected from burns. The most conscientious and valuable application of X-ray therapy can be obtained only when the doses given by various roentgenologists can be measured in international roentgens with sufficient accu-

racy to be subject to duplication within that narrow margin requisite for the proper physiologic reaction.

Formerly, many roentgenologists (lacking accurate means of measuring doses in roentgens) found it necessary to protect both themselves and their patients by giving a dose with a large safety factor, on many occasions stopping just short of an otherwise successful treatment.

Attempts to obtain even reasonable accuracy were forestalled by the mechanical handicaps and practical difficulties involved. It was necessary to sacrifice shielding and insulation for convenience and simplicity, with the result that scattered radiation (which often existed in unbelievable quantities), leakage, etc., caused errors of sufficient degree to embarrass any correction which might otherwise have been made for wave length, etc.

Due to their inherent characteristics, electrometers do not follow a linear displacement law with respect to potential and the displacement curve varies with different electrometers of the same type. Until recently, therefore, the scales of dosage instruments were divided into arbitrary units and a conversion table was necessary, by which to convert to the units in which the instruments were calibrated. Most of these instruments were characterized by a large wave length dependence and, as a consequence, were intended to operate only on filtered radiation, and were, then, correct only on the shorter wave lengths.

In the past it was almost impossible for the maker and designer of these instruments to visualize the clinical conditions under which such an instrument must function day after day and the amount of unintentional abuse which it would receive in actual practice. Consequently, earlier instruments were built along the lines of laboratory instruments rather than for the practising clinician.

Knowledge gained through experience has now enabled manufacturers to overcome problems which at first seemed insurmountable. Electrometers are now made with almost linear scales so that they can be marked directly in roentgens and so calibrated that no correction is necessary under normal conditions. Instruments have been developed which employ a small ionization chamber which can be placed at any point of irradiation. These instruments are now available in practical form and are of sufficient accuracy to provide the roentgenologist or physicist with the information he requires.

Furthermore, they are now entirely self-contained, weigh approximately ten pounds, and are thoroughly shielded. Even if the scale is read and the value used without any correction factor for wave length, temperature, etc., the error under reasonable conditions will be less than 5 per cent.

Undoubtedly, as stated before, the greatest single advancement in X-ray dosimetry was the adoption of an international unit. The physical apparatus and method involved to fulfill the requirements of this definition have been described elsewhere (1). This type of primary standard is now used by the U. S. Bureau of Standards, by the physical laboratories of the foremost clinics, and by the manufacturers to calibrate the various dosage instruments (or r-meters) already on the market.

As the international unit was, for physical reasons, defined as being measured at 0° C. and 760 mm., measurements made with an air chamber must, therefore, be corrected for temperature and barometric pressure in accordance with the formula:

(1) $I' = I''\ (1 - .00367\ t)\ 760/p$

where:

I′ is the intensity in roentgens corrected to zero and 760 mm.

I″ is the intensity measured in air at room temperature

t is room temperature

p is barometric pressure

The following Tables Nos. 1 and 2 are derived from Formula (1) and show the effect of temperature and barometric pressure on the readings of a standard air chamber. The factors Kt and Kp are given as the correction factors for showing separately the effect of temperature and pressure. The same factors apply to any of the ionization r-meters.

CORRECTION FACTORS

TABLE 1
Temperature

Degrees C.	Degrees F.	Factor Kt	
0	32	1.000	
2	35.6	1.007	
4	39.2	1.014	
6	42.8	1.022	
8	46.4	1.029	
10	50.0	1.036	
12	51.8	1.044	
14	57.2	1.051	
16	60.8	1.0586	.9780
18	64.4	1.0661	.9854
20	68.0	1.0734	.9927
22	71.6	1.0807	1.0000
24	75.2	1.0881	1.0074
26	78.8	1.0955	1.0148
28	82.4	1.1017	1.0220
30	86.0	1.110	
32	89.6	1.117	
34	93.2	1.125	

TABLE 2
Pressure

Inches	Mm.	Factor Kp
28.34	720	1.055
28.54	725	1.048
28.74	730	1.040
28.93	735	1.033
29.13	740	1.025
29.33	745	1.020
29.52	750	1.011
29.72	755	1.005
29.92	760	1.000
30.11	765	.993
30.31	770	.987
30.51	775	.980
30.70	780	.974
30.90	785	.968
31.10	790	.962

It may be seen that if an r-meter has a scale marked in roentgens it must be calibrated by one of two methods:

(1) Roentgens corrected to zero,

(2) Roentgens to be corrected to zero.

From the temperature table, it will be noted that, if the scale is calibrated according to Method 2 under normal conditions (referring to "roentgens corrected to zero"), the scale will always read about 8 per cent high if used at 22° C. and 760 mm., this factor varying according to the temperature and pressure. A factor of this magnitude is inconvenient and there is always a possibility that the factor will be neglected and an error of approximately 8 per cent made.

By the use of Method 1, the r-meter is calibrated to read "roentgens corrected to zero" at one definite temperature and pressure and the corresponding factors included in the calibration. If the temperature and pressure selected are the ones under which the instrument is normally operated, no correction is necessary and under average conditions the error may be so small as to be disregarded.

To obtain correction factors for r-meters calibrated to read "roentgens corrected to zero" when used at a fixed temperature and pressure, Tables 1 and 2 may be combined as in Table 3. This table shows the factors to be unity at 22° C. and 760 mm., with a change of about ⅓ of 1 per cent for each degree centrigrade and a change of over 1/10 of 1 per cent for each millimeter pressure (Table 3).

One American manufacturer has recently changed the instruments of his manufacture to read "roentgens corrected to zero," this being specified on the calibration card. Formerly, these instruments (though not so marked) were calibrated in roentgens as measured at normal temperature and pressure, which may be assumed to be 22° C. and 760 millimeters. In stating dosage in roentgens, therefore, it must be specifically stated whether or not correction has been made for temperature and pressure conditions. A statement of the effective wave length rather than conditions of irradiation should also be given. Due precautions are, therefore, necessary when comparing different measuring instruments.

Throughout this article the phrase "roentgens corrected to zero" has been used in the sense that there are two units of measurement. This, however, is not true. Strictly speaking, the statement of a dose in roentgens implies that the correction has been made, for the international roentgen is defined as being measured at, or corrected to, 0° centigrade. However, it would seem that in stating dosage in roentgens the use of the extra notation, "roentgens corrected to zero," would be of value in assuring parametric accuracy in a field where the elimination of such errors is of much importance.

This tabulation applies only to r-meters calibrated to read "roentgens corrected to 0° centigrade and 760 mm. pressure."

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TABLE 3

Temperature

		°F. 60.8	64.4	68.0	71.6	75.2	78.8	82.4
Inches	Mm.	°C. 16	18	20	22	24	26	28
28.34	720	1.0322	1.0400	1.0477	1.0555	1.0633	1.0711	1.0787
28.54	725	1.0249	1.0327	1.0403	1.0480	1.0557	1.0635	1.0710
28.74	730	1.0180	1.0258	1.0334	1.0410	1.0487	1.0564	1.0639
28.93	735	1.0112	1.0189	1.0264	1.0340	1.0416	1.0493	1.0567
29.13	740	1.0044	1.0120	1.0195	1.0270	1.0345	1.0421	1.0495
29.33	745	.9976	1.0052	1.0126	1.0201	1.0276	1.0351	1.0425
29.52	750	.9910	.9985	1.0059	1.0133	1.0207	1.0282	1.0356
29.72	755	.9844	.9919	.9992	1.0066	1.0140	1.0214	1.0287
29.92	760	.9780	.9854	.9927	1.0000	1.0074	1.0148	1.0220
30.11	765	.9715	.9789	.9861	.9934	1.0007	1.0081	1.0152
30.31	770	.9652	.9726	.9798	.9870	.9943	1.0016	1.0087
30.51	775	.9590	.9663	.9735	.9806	.9878	.9951	1.0021
30.70	780	.9530	.9601	.9673	.9744	.9816	.9888	.9958
30.90	785	.9470	.9542	.9612	.9683	.9754	.9826	.9896
31.10	790	.9408	.9479	.9551	.9621	.9692	.9763	.9832

PROPER CO-ORDINATION AMONG SURGERY, RADIUM, AND X-RAY THERAPY IN CANCER OF THE BREAST[1]

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THE female breast presents an organ in which cancer develops with great frequency. Twenty per cent of all cancers in the female and 10 per cent of *all* cancers occur in the female breast. Although only 1 per cent of all cases of cancer of the breast occur in the male, one must not lose sight of its occurrence.

At the first glance it would seem that a cancer which is not situated in one of the cavities of the body, but in an organ which is located on the surface of the skin and is easy of access, should be comparatively easy to control. In reality, however, cancer of the breast presents to-day one of the most complex problems diagnostically as well as therapeutically. The reason for this lies in the fact that the various types of carcinoma of the breast differ greatly in their clinical course and in their grade of malignancy. These clinical differences consist in the greater or lesser rapidity of the local growth and the frequency of the occurrence of distant metastases. A scirrhous carcinama of the breast may remain localized for years without disturbing the rest of the organism, while a medullary carcinoma may kill the patient in a few months or even weeks.

In some cases the carcinoma of the breast which appears to be in an early stage will recur locally soon after a most radical operation, and throughout the whole subsequent course of the disease no metastases will be noted in the lungs, liver, or in the skeleton.

In other cases the result of the operation will be apparently perfect, there will be no local recurrence, nor will there appear any metastases in the lymph nodes of the axilla or of the supraclavicular region. At the same time, as late as twenty years after the operation a metastasis will occur in the head of the femur or in the pelvic bones or the spine.

This diversity of behavior of the different types of carcinoma of the breast, or even of apparently the same type in different individuals, indicates the difficulties in the evaluation of the different therapeutic procedures by the aid of a statistical analysis of the material studied. It also indicates what a complicated problem it is to ascertain in each individual case of a tumor or a lump in the breast whether or not it is malignant and, if the former, how far advanced the condition is. Therapeutic results must naturally vary accordingly.

DIAGNOSIS OF EARLY CANCER OF THE BREAST

Advanced cases of carcinoma of the breast present no difficulty in one's making a correct diagnosis. These advanced cases, however, at the same time are generally beyond any efficient therapeutic help. It is in the early stages of carcinoma of the breast that excellent results are obtained by the aid of the modern method of therapy, but the establishment of correct diagnosis in this type of case frequently offers great difficulties.

A diagnosis of early carcinoma of the breast may be arrived at on *palpatory evidence alone* but in many instances it cannot be made without a *gross inspection or a microscopic study of a frozen section* of the excised tumor.

When a woman presents herself to a physician with the statement that she has found a *lump* in her breast, has experienced *pain* in her breast, or noticed some abnormal discharge from the nipple, it may be well for

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the examining physician to disregard the patient's statement as to which breast she found the abnormality in, because, although subsequent examination may show that she actually has a malignant tumor in the breast mentioned, she may have no tumor in either breast, or she may have cancer in the opposite breast.

Method of Examination.—Each patient must submit to a complete examination of both breasts and all of the adjacent areas in which primary or secondary cancer may develop. The patient should be stripped to the waistline or completely, so as to make it possible to examine the abdomen, pelvic bones, vertebræ, and femurs. The patient reclines in the supine position on a couch or table with both arms raised over her head. An inspection is then made of the breast and chest wall, any abnormalities being noted. It should be seen whether the breasts are equal in size, what size they are, whether there is a bulging noted in either, whether the nipples are normal or retracted or ulcerated, whether there is a discharge coming from a nipple upon pressure, and whether there is a dimpling of the skin of the breast anywhere. A palpation is then done of both breasts, each with one hand so that the thumb may be placed over the anterior surface of the breast and the rest of the hand over the posterior. The consistency of the breasts is noted. If, in a woman above twenty-five years of age, it is found that there is one distinct mass in one breast and all the rest of the involved breast and the other breast are soft, and if this mass appears to be passing diffusely into the surrounding tissues, then the diagnosis of carcinoma is so certain that there is no necessity for any additional diagnostic evidence.

In these cases in which the diagnosis of malignancy is certain, the next step consists in ascertaining if there are any metastases present anywhere. The axillæ are palpated, the supraclavicular regions, the liver, then the vertebræ, for localized pain which may indicate early metastases in the skeleton. An X-ray examination is then done of the chest and most of the skeleton, particularly of the spine, pelvic bones, and heads of the femora. Since 1917, the writer has advocated this method of X-ray examination of a patient before the operation.

"Frozen Section" Diagnosis.—In a young person an encapsulated tumor freely movable within the breast tissue is most usually a benign adenofibroma or cystadenoma. However, a certain number of these benign tumors undergo malignant degeneration. Furthermore, cases of true carcinoma of the breast have been observed in girls 16 and 17 years of age. In view of all this, it is hazardous to make a diagnosis on palpatory evidence alone, even when a simple tumor is palpated in one breast.

The difficulties in the way of diagnosis are greater in those cases in which the involved breast or both breasts contain numerous lumps of different sizes and consistency. This condition, which is known under the term of *chronic cystic mastitis,* is usually benign in its character. There is, however, a good deal of evidence that carcinoma of the breast may be surrounded by breast tissue which shows the changes characteristic of chronic cystic mastitis. Therefore, when a patient is examined and both breasts are found to be lumpy, but one of the lumps appears to be harder in consistency than the rest, this lump may have undergone malignant degeneration.

In these cases, as well as in the cases in which there is only one and that apparently an encapsulated tumor, the correct procedure is to excise the tumor, then cut through it with a scalpel. If it appears on gross inspection that the tumor is malignant then a radical mastectomy should be done immediately. If the diagnosis cannot be established by gross inspection alone, then a frozen section

for microscopical examination should be taken of this tumor while the patient is in the operating room. If it is shown to be malignant, then a radical mastectomy should follow.

The preliminary excision of the tumor is done through the posterior incision of the radical mastectomy. The tumor is excised with the surrounding normal breast tissue and, if malignancy is found, the subsequent steps of the radical mastectomy are done. The excision of the tumor is done very widely within normal gland tissue to obviate the possibility of cutting into the tumor itself while it is *in situ*. Should the result both of gross inspection and of the frozen section be negative, then the wound is closed. By such procedure unnecessary mutilation through removal of breasts with benign conditions is obviated and at the same time cases of early cancer of the breast are treated correctly.

The following case may illustrate the advisability of surgical exploration of cases of double chronic cystic mastitis.

Case 1. A. B., aged 41, was admitted to the hospital on April 21, 1924. On examination both breasts were found to be lumpy. In the left breast one diffuse mass was nodular and harder than the rest. This mass was excised in the manner described above and frozen sections prepared. Three slides showed chronic cystic mastitis, but the fourth showed an area of carcinoma surrounded by chronic cystic mastitis. A radical mastectomy was done. Subsequent analysis showed that a small lymph node in the axilla, which could not be palpated before the operation, contained metastatic carcinoma.

SURGERY AND PRE- AND POST-OPERATIVE RADIOTHERAPY IN OPERABLE CARCINOMA OF THE BREAST

As is seen above, surgery in cancer of the breast is the first therapeutic method, since it represents not only a therapeutic but also a diagnostic method; thus the fact that radical mastectomy is the method of choice in early cancer of the breast requires no discussion. There is no such unanimity of opinion in regard to the advisability of *preceding or following* such an operation by radium or X-ray therapy. The opinions are based on statistical evidence, and, as was stated above, various groups of cases of cancer of the breast differ to such an extent in their clinical behavior that a comparative statistical analysis must be of little value.

In order to appreciate the actual value of pre- or post-operative radiotherapy, a clear conception must be obtained of the rationale of radiotherapy in cancer in general and of the meaning of pre-operative or post-operative radiotherapy in particular.

For nearly two decades, in collaboration with my associates, I have investigated the biologic and therapeutic influence of radium and X-rays on malignant tumors of plants, animals, and humans. It would lead far afield to describe here the experiments and the clinical and pathologic investigations which form the basis for the conceptions as to the real value of radiotherapy in cancer. Those interested will find some of the results in the bibliography at the end of this article.

The mechanism of the action of radium and X-rays on malignant tumors must be considered in the following way:

The first morphologic changes which occur in carcinoma or sarcoma tissue under the influence of radium and X-rays are observed in the tumor cells themselves, and are manifested by the vacuolation of the protoplasm, pyknosis of nuclei, karyolysis, and ultimately complete necrosis of the cell. These cellular changes are accompanied by a round cell infiltration which replaces the destroyed cancer cells. Subsequently this round-cell infiltration is changed into dense sclerotic connective tissue, poor in blood vessels. This con-

nective tissue formation may become very extensive, surround islands of cancer cells, and assist in the destruction of the latter. Furthermore clinical and experimental investigations have shown that radium and X-rays may impair deeply the proliferating power and consequently the clinical malignancy of the tumor without producing any apparent change in its morphologic appearance.

The following case, reported previously, may serve to illustrate this point.

Case 2. W. Y., female, aged 40, was admitted to the hospital in August, 1915, with a hard mass the size of a hen's egg in the outer margin of the right breast. The skin was adherent to the tumor, and there were enlarged lymph nodes in the right axilla. A clinical diagnosis was made of carcinoma of the breast, with involvement of the axillary lymph nodes. The general condition of the patient precluded any operative interference, and she was treated by local application of radium to the breast and axillary nodes, and roentgen rays through the chest wall. The breast tumor and the gland at first diminished somewhat in size and then remained stationary. Seventeen months later the patient died. At the autopsy, a close search was made for possible metastasis but none was found anywhere in the organism. This microscopic examination of the tumor of the breast showed a scirrhous carcinoma and the lymph nodes of the axilla were filled with solid carcinoma. Nevertheless, nearly a year and a half after the condition was discovered no dissemination or distant metastasis was found anywhere in the organism.

As a rule, if left untreated, a patient with carcinoma of the breast with involvement of the axillary nodes dies in less than a year and a half from a general dissemination of the carcinoma. It is thus quite evident that in the case reported here radium and X-ray therapy inhibited the further growth and dissemination of the carcinoma tissue, transforming it, as it were, into a biologically and clinically benign type of tumor, though it did not change its morphologic appearance. Indeed, it is quite probable that the first effect of the rays on every malignant tumor is the inhibition of the proliferating power, the *sterilization,* as it were, of the cancer cells. The degeneration and destruction of the cancer cells and the formation of the sclerotic connective tissue take place subsequently under the influence of the rays. Moreover, this cell degeneration and cell death may not be due directly to the action of the rays, but take place in the natural course of the life of the cancer cell. This cycle consists of *youth,* or period of development; *maturity,* or period of function, and *senility,* or period of degeneration, which gradually leads to death. In parenchymatous organs, such as the liver and kidney, the first period is usually completed during embryonic life or at a very early age. The second period continues through the whole life of the organism, and the third period is attained at the old age of the organism or near its death. The life of an individual cancer cell, on the other hand, is very short. It changes rapidly from an embryonic into an adult and then immediately into an aged, degenerated cell, this process taking place continuously, irrespective of any extrinsic aid. But in a malignant tumor the majority of the cancer cells are quickly rejuvenated before they reach senility through the fact that each cancer cell divides into two young daughter cells. When the rays arrest this proliferation, then, without any further outside aid, the cancer cells mature and degenerate. It is interesting to note in this connection that the life of the epithelium of the skin or testicle is nearly as short as that of malignant tumors, and the rays act on those organs as specifically as they do on malignant tumors.

The round-cell infiltration, which sur-

rounds the group of irradiated cancer cells, and is subsequently changed into dense sclerotic connective tissue, is of secondary occurrence, though for practical purposes it is of greater importance than the destruction of the cancer cells themselves. The important rôle of this connective tissue consists in the following: after the most perfect results of radiation, a certain number of viable though stunted cancer cells may remain; the dense connective tissue wall surrounds these cells and keeps them in check. The formation of the connective tissue around the radiated cancer cells is not due to the direct influence of the radiations, and radiation of other parts and conditions, like the thyroid gland, keloids, etc., is not followed either by round-cell infiltration or by connective tissue formation. The experimental investigations also indicate that, apparently, this connective tissue formation represents an attempt by the organism to protect itself against the further growth of the cancer by walling it off from the normal tissue by a connective tissue barrier.

The practical application of these experimental and clinical observations is self-evident.

Radical surgery in carcinoma of the breast when there is no involvement of the axillary lymph nodes is successful in about 70 per cent of the cases. This means that after the operation, in about 30 per cent of the cases, minute islands of carcinoma are left behind somewhere in the organism. Post-operative radiotherapy in these cases is employed, not prophylactically, as we conceive of it in bacterial diseases, but in order to inhibit or destroy these remaining minute nodules of carcinoma. During the last two decades a sufficient amount of clinical evidence has accumulated to prove that fully developed primary and metastatic nodules may be destroyed by the aid of radiotherapy. It is undoubtedly much easier to accomplish such a destruction when each nodule is so minute that it cannot be discovered by any means at our command.

Pre-operative irradiation is not essential in the early cases since there is no probability of operative dissemination. Moreover, as shown above, the diagnosis is frequently established only during the operation.

In carcinoma of the breast with involvement of lymph nodes in the axilla, radical surgery is successful in about 25 per cent only of the cases. These poor results, as compared with the results obtained when the axilla is free of carcinoma, can evidently be due only to the fact that dissemination takes place before or in the course of the surgical removal of the carcinomatous lymph nodes in the axilla. That a certain percentage of these cases, be it ever so small, must be benefited by pre-operative irradiation is self-evident.

RADIOTHERAPY AND SURGERY IN ADVANCED CANCER OF THE BREAST

In advanced cases of carcinoma of the breast in which there is a large metastatic tumor found in the axilla and no other distinct metastasis found on clinical and X-ray analysis, the therapeutic procedure is as here outlined. Capillaries of radon are inserted into the tumor mass of the breast and into the mass in the axilla. For the technic of insertion I refer to my previous publications on the subject. Under this treatment the tumor shrinks and becomes movable off the chest wall. From four to six weeks later, when both tumors have shrunk considerably, a mastectomy may be performed, followed by post-operative radiotherapy.

RADIUM INSERTION AND MASTECTOMY IN ULCERATING TUMORS OF THE BREAST

A patient suffering from a large ulcerating tumor of the breast which constantly secretes foul discharge is a burden to herself and to her associates. When there

is no evidence of multiple metastatic nodules in the skin surrounding the ulcerating tumor, then the case is treated in the following manner. An insertion of radon capillaries is done into and around the ulcerated area of the tumor, followed by surface application of radium and X-ray therapy. After a period of from four to six weeks the ulcer generally becomes diminished in size and the tumor becomes more freely movable off the chest wall. A mastectomy is then done, with the removal of the pectoral muscles and with a more or less complete cleaning of the axilla, depending upon the conditions found. Only enough skin is removed to permit one to excise widely the ulcerated area and to allow for an immediate primary union.

It must be clearly understood that this represents only a palliative procedure. It seems, however, not only to prolong life but (and this is its main advantage) to make the life of the patient more bearable. It is much more comfortable for the patient, both bodily and mentally, to succumb ultimately to internal metastases than to live for months with a large, fungating, carcinomatous ulcer.

The following cases may serve to illustrate this method.

Case 3. M. E., white, female, aged 63, was admitted to the hospital on May 21, 1925. Seven months previous to admission she had noticed two areas, like pimples, beneath the right nipple. Lumps grew, hard in consistency, which later ulcerated and bled.

On examination of the right breast the nipple was found to be replaced by an indurated mass. Another mass was noted in the lower outer quadrant of the breast, ulcerated at the center. The masses were firmly adherent to the chest wall. The diagnosis of carcinoma of the breast was proved microscopically from a biopsy specimen taken from the ulcerated area. On June 10, 1925, a radon insertion was done into the two carcinomatous masses of the breast, followed by X-ray therapy. On the 12th of August a mastectomy was performed. The wound healed by primary union. When the patient was seen last, 18 months later, there was no local recurrence.

Case 4. S. C., white, female, aged 69, was admitted to the hospital on May 22, 1924. The patient had noticed a lump in her right breast which gradually grew larger until its size at examination was reached. It ulcerated through the skin and there was some serous and bloody discharge. On examination a stony, hard, spheroid mass *in the upper half of the breast* was found. It was about the size of a grape fruit and was attached to the skin, but was movable off the deep structure. There was an altered skin area, roughly circular in shape and 6 cm. in diameter, overlying the central part of the tumor. This area was erythematous and showed a few bloody blebs, with ulceration. The right nipple was drawn upward toward the tumor. In the right axilla there was a large stony-hard mass which was somewhat movable over the underlying tissues. No distant metastases were noted. The diagnosis of advanced cancer of the breast was proved microscopically from a biopsy specimen taken from the ulcerated area. On June 21, 1924, radon capillaries were inserted into the ulcerated area of the breast. The tumor shrank and the ulceration diminished in size. A mastectomy was performed on July 24, 1924. The wound healed by primary union and the patient improved rapidly in her general condition. When she was last seen, 16 months after the operation, her condition seemed to be perfect. There was no evidence of local recurrence, nor was the function of the right arm impaired.

Case 5. M. D., white, female, aged 77, was admitted on August 3, 1929, with a history of a mass of two months' duration in

the right breast and bluish discoloration of the skin over this mass. On examination the right breast appeared smaller than the left and was pulled to the right and upward. One inch above and to the right of the nipple there was noted a round ulcer one inch in diameter, somewhat elevated above the surface of the breast, and pinkish red in color. The center of this ulcer was covered by a black, firmly adherent scab. On palpation the base of the ulcer was very hard and was attached to a diffuse mass which occupied the right upper quadrant of the breast. The right axilla contained several lymph nodes, hard in consistency. No distinct masses were noted. The diagnosis of advanced cancer of the breast was proved microscopically. On August 27, 1929, capillaries of radon were inserted into the ulcerated area of the tumor. On September 5th, the mass had diminished in size and had become softer in consistency. On October 29th, mastectomy was done. The wound healed by primary union and the local and general conditions have been good since.

Case 6. A. H., white, female, aged 45, entered the hospital on June 27, 1929. About one year previously, the patient had begun to suffer pain in her left breast. Later the pain became aggravated and the patient noticed a lump. On examination, both breasts appeared small, unequal in size, not pendulous. The nipples were not retracted. The right breast was the smaller and to palpation felt soft throughout. The left breast was irregular in shape. A tumor mass measuring 7 by 6 cm. in diameter occupying the upper outer quadrant of the organ was noted. The surface of the mass was covered with an ulceration like a cauliflower in appearance, purplish red in color. To palpation the mass appeared fleshy and elastic in consistency, and somewhat movable over the chest wall. There was some serosanguineous discharge exuding. A hard and nodular mass was felt in the axilla, but no distant metastases were noted. The diagnosis of advanced cancer of the breast was confirmed microscopically. On July 12, 1929, capillaries of radon were inserted into the tumor. On August 25th, the masses in the left breast and axilla diminished in size. On September 18th, a second insertion of radon was made. On October 6th, the tumors were found further diminished in size. On October 25th, a mastectomy was done, the wound healing by primary union. The patient gained eighteen pounds in weight and is clinically well up to the present time.

In this type of case, the intratumoral insertion of radon is the main method of therapy, and surgery is used only as an adjuvant.

When the tumor involves the whole breast and is firmly adherent to the chest wall in its entirety, no attempt at surgery should be made. The following case illustrates this condition.

Case 7. M. P., white, female, aged 39, was admitted to the hospital on March 25, 1930, with a history of having noticed a mass in the right breast 18 months previously and an ulceration for six months before coming to the hospital. The patient also complained of dyspnea. On examination, the right breast was found to be transformed in its entirety into a flat, hard and nodular tumor mass, measuring about 15 cm. in diameter and about 3 cm. in thickness, irregularly round in outline, and firmly adherent to the chest wall. Surrounding and partly undermining the nipple was a flat ulceration measuring about 8 cm. in diameter. A hard and nodular tumor measuring 3 cm. long and 2 cm. thick was found in the axilla. On percussion of the chest, the right side showed dullness everywhere, and, on auscultation, total loss of breath sounds. X-ray analysis showed an opacity throughout the right side, with the exception of a small area just beneath the inner aspect of the clavicle. No

distant metastases were found. A diagnosis of carcinoma of the breast with metastasis to the pleura was made, which was later confirmed microscopically. On March 27th, a thoracentesis was done and 1,000 c.c. of straw-colored fluid obtained. Then a biopsy specimen was taken from the ulcerated area and radon capillaries inserted into the tumor of the breast and of the axilla. On June 20th, the thoracentesis and the radon insertion were repeated. This was followed by X-ray and surface radium therapy. No further thoracentesis was necessary. The formerly ulcerated area is covered with skin and according to the last X-ray analysis the right lung tissue appears clear throughout the upper and middle lobes. Neither of the tumors is palpable at present.

SURFACE RADIOTHERAPY IN ADVANCED CASES AND IN SKELETAL METASTASES

In post-operative recurrence and in cases with metastases into distant organs, only temporary palliative results may be expected from either surgery or radiotherapy. However, even in this type of case very gratifying results may be obtained.

Metastases into the supraclavicular lymph nodes, which appear subsequent to a radical mastectomy, give generally a poor prognosis. The method of therapy for these cases is the following: an incision is made over the palpable tumor in the supraclavicular region, radon capillaries are inserted into the tumor mass, and the skin incision closed. This is followed by surface applications of radium and by X-ray therapy. In several instances the patients so treated have remained clinically well for from two to four years.

Most remarkable results are obtained occasionally in the treatment of skeletal metastases from carcinoma of the breast by the aid of surface application of radium and X-ray therapy.

The following cases may serve as illustrations:

Case 8. M. F., female, aged 54, suffering from cancer of the left breast, developed a pathologic fracture in the middle of the shaft of the right humerus. Roentgenogram showed complete destruction of the bone of the diaphysis of the humerus in an area over 5 cm. long. There was no evidence of skeletal metastases elsewhere. The method of treatment consisted in covering the fracture area with three packs of radon. One pack was placed over the anterior surface, another over the external, and the third over the internal surface of the humerus. In all, 208.9 millicuries of radon were applied for sixteen hours. The splints were applied over the packs to retain the correct position of the bone. One week later 249.1 millicuries were similarly applied for sixteen hours. The following week, or two weeks after the first radon application, a roentgenogram showed a callus formation and the ends of the bone in good position. The patient could support her arm without splints.

Such a prompt formation of a functionally perfect callus in a pathologic fracture, which did not show any evidence of osteosclerosis on the first roentgenograms, indicates that radium therapy may aid in new bone or callus formation in all pathologic conditions of the skeleton accompanied by osteoporosis or destruction of bone.

Case 9. D. L., female, aged 40, entered the hospital on November 10, 1915. The patient had had a radical mastectomy done in the previous May. A few weeks after the operation she began to experience severe pain in the lumbar region, loss of weight, and general weakness and inability to walk. A roentgenogram of the spine taken on admission showed a slight destruction of portions of the second and third lumbar vertebræ with some osteoplasia in the form of bridges on both sides. Clinically the patient was suffering from painful paraplegia (par-

aplegia dolorosa Charcot). She received radium and X-ray treatments. One year after admission she left the hospital greatly improved, able to walk around and work. A later roentgenogram showed increased new bone formation in the region of the second and third vertebræ. The patient remained clinically well, but died six years later in diabetic coma.

Case 10. T. C., female, aged 36, entered the hospital on March 22, 1922. On admission she was suffering with paraplegia and complained of severe pain in her back and inability to move. X-ray analysis showed diffuse metastases of the skeleton involving the *dorsal* and *lumbar spine* and *all the pelvic bones*, as well as the *skull*. Subsequently the *cervical spine also* became involved so that the patient was lying rigid in bed without being able to move either her lower extremities or her head. At one time respiration became extremely difficult. The patient remained at the hospital for two and one-half years, until late in November, 1924. In the course of her stay at the hospital, she received surface radium applications and X-ray treatments practically throughout her whole skeleton. She gradually began to improve so that toward the end she was able to walk about without any support or help, had practically no pain anywhere, and at her own request was discharged in November, 1924. Examination of the skeleton revealed a great deal of new bone formation throughout, which apparently made the spine firm and healed the clinical paraplegia.

This case is very remarkable in view of the complete generalization and immense amount of metastatic carcinoma throughout the organism and also in view of the large amount of therapy which the patient received in the course of two and one-half years. While it is fairly certain that all of the carcinoma tissue has not been destroyed within the organism, the clinical result is very striking. A bedridden patient with paralysis of both lower extremities, with severe pain on the least movement of any joint, was able to leave the hospital, to walk about, and to take care of herself.

SUMMARY

Of patients suffering from cancer of the breast who present themselves to the surgeon for treatment to-day, only a small percentage are in the early stage of the disease in which the axillary lymph nodes are involved. The improvement of this deplorable situation depends entirely on the *education of the public* to the necessity of seeking immediate medical help on discovering the least abnormality in the female breast. Of greater importance still is the *education of the profession* to recognition of the condition in time and to appreciation of the urgent necessity of taking care of these patients at the earliest possible moment.

In the early stages of the disease when the axilla is not involved, radical surgery, as stated before, gives excellent results, and about 75 per cent of the patients remain well five years after the operation. But even in this type, the condition recurs in not less than 25 per cent of the cases. If all the so-called operable cases, which include the cases which show involvement of the lymph nodes in the axilla and in the supraclavicular region, are analyzed, then surgery alone is probably successful in less than 25 per cent of the cases operated on.

If we further consider the remarkable palliative results which are obtained by the aid of radium and X-ray therapy, as has been shown in the different groups of cases in this presentation, and take into consideration the biologic and clinical principles which form the foundation of the efficacy of radiotherapy in cancer, it is quite evident *a priori* that the addition of radium and X-ray therapy will increase the percentage of cases that will remain well for five years or longer.

Cancer of the breast presents many path-

ologic and clinical variations. The correct combination of surgery, radium, and X-ray therapy which will give the most satisfactory results must be determined for each individual case.

CONCLUSIONS

1. Every tumor in the female breast must be considered suspicious for malignancy unless definitely proved to be benign.

2. Malignancy may be present even when both breasts are in a state of *chronic cystic mastitis.*

3. When in doubt, a diagnostic wide excision of the tumor should be done, a *gross or frozen section* diagnosis made, and, if malignancy is established, a radical mastectomy done immediately.

4. Radiotherapy, pre- or post-operative, or both, must be added in every case of positive malignancy in the breast.

5. Pre-operative radiotherapy may change an inoperable cancer of the breast into an operable one.

6. Inoperable *ulcerated* cancer of the breast may be improved considerably and the ulcer healed by radium insertion. This may be followed by a mastectomy.

7. Excellent results may be obtained by the aid of radiotherapy in skeletal metastases of carcinoma of the breast.

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THE EVOLUTION AND PRESENT STATUS OF ELECTRO-SURGERY IN THE TREATMENT OF CANCER[1]

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NOT the least interesting feature of the history of high frequency currents is the fact that much of the original experimentation was done by physicians. Ever since Dr. William Gilbert, surgeon to Queen Elizabeth, in 1600, published his work, "De Magnete," and laid the foundations of our modern conceptions of electricity, physicists and physicians have been attracted to this great force and its possible service to man. Nearly two hundred years later Galvani, an Italian physician and a professor of anatomy, accidentally discovered the muscular contractions produced by the current to which he gave his name, and before the middle of the nineteenth century (about the time that Faraday was announcing his discovery of induction), Joseph Henry, an American, described the oscillatory character of the discharge from the Leyden jar.

Henry not only understood the oscillatory nature of these waves, but proved experimentally that a spark about one inch in length from the prime conductor of an electrical machine to a wire circuit in an upper room produced inductive effects capable of magnetizing needles in a parallel circuit placed in the cellar, although this was thirty feet below the upper floor and separated from it by two floors each fourteen inches thick.

This demonstration did not attract further attention until it was taken up by Hertz in 1888, when he succeeded in producing a series of electric oscillations of very high frequency. D'Arsonval thereupon showed that muscular contractions cease with 10,000 oscillations per second and this number has been taken arbitrarily as the dividing line between currents of high frequency and low frequency.

In his book, "History of Electrotherapy and Diagnosis," Colwell says: "The actual production of heat within the tissues themselves as the result of the passage of an electric current of high frequency was first suggested by Nicola Tesla in 1891. D'Arsonval, in February of that year, made a communication to the Société de Biologie in which he stated the possibility of passing a high frequency current of three amperes through the body with no other sensation than that of heat."

Doyen, whose researches on the penetration of heat began in 1896, presented to the French Surgical Congress in 1907 a well conceived method of destroying accessible cancer by electrocoagulation. One of his important conclusions was, "Of all means employed in the destruction of pathological tissues the only certain method is that of heat." In 1908, Nagelschmidt, at the Buda-Pesth Congress, demonstrated a specially designed apparatus for producing this heating effect and introduced the name "diathermy." It is evident that although the use of the word "diathermy" at that time represented an effort at exactness, it is inadequate to-day to cover all that is being done with high frequency currents.

Neither Doyen nor Nagelschmidt knew anything of the monopolar desiccating current, first discovered by Dr. Finley R. Cook, of New York, and later developed by Dr. William L. Clark, of Philadelphia. Neither did they know of the endotherm knife, the first perfected cutting current which was presented by the writer at Rochester in April, 1924, before the Surgical Section of the New York State Medical Society. A detailed description was published in May of

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, California, December 1–5, 1930.

that year in the *American Journal of Electrotherapeutics and Radiology*. It will be noted that this antedated the work of Bovie and Cushing by more than four years.

In connection with this early experimentation and development of the surgical application of high frequency currents to disease, the names of King, Riviere, de Keating-Hart, Kowarschik, Eitner, Beer, Keyes, and others should be enrolled.

In order to evaluate electrosurgery in the treatment of cancer it is essential first to analyze precisely what may and what may not be expected from radiation therapy. Out of a maze of conflicting evidence, confusing statistics, and unsound conclusions, the true value of radiation and its limitations are only now beginning to be appreciated.

It is important to realize that at its inception radiation in the treatment of cancer was surrounded with extreme difficulties. The most important of these was the fact that at first only hopelessly inoperable cases were subjected to treatment. Furthermore, the development of the technic of radiation has continued over a period of years and some of the most important advances have been made only in the last two or three years. Finally, newer studies on the radiosensitivity of tumors—correlating microscopic structure with radiation response—have removed radiation from the empirical sphere and placed it on a more scientific basis.

The fundamental principle—the governing law of radiation therapy—has been pronounced most clearly by Regaud. He states that only those tumors are amenable to radiation whose radiosensitivity is sufficiently greater than the radiosensitivity of the surrounding tissues to permit a destruction of the tumor and conservation of the tumor bed. A full appreciation of this principle is essential in order to enable one to realize the value of radiation on the one hand and its limitations on the other.

On the basis of radiation therapy there are two general groups into which all tumors may be divided: radiosensitive and radioresistant. An analysis of the types of neoplasms which have yielded satisfactorily to radiotherapy promptly reveals the fact that, aside from all other considerations, they possess the property of radiosensitivity. Similarly, an analysis of radiation failures reveals that the unfavorable results can be explained largely on the basis of radioresistance.

It is also important to realize that radiosensitivity does not necessarily imply a favorable prognosis. Unfortunately, the most radiosensitive lesions are, as a rule, the most cellular and malignant neoplasms we encounter. They are commonly the tumors that grow rapidly and disseminate early in their career. Consequently, although they exhibit a primary, well marked and often rapid response to radiation, they too often either recur locally or soon show evidence of distant metastasis.

It is my special purpose to-day to discuss the avenues along which electrosurgery constitutes a method of attack, particularly upon that group of neoplasms which experience has demonstrated to be unsuitable for radiation therapy. As a rule, the radiosensitivity of a tumor can be determined by the rapid frozen section method, which can be carried out as an office routine. From a purely technical point of view, the removal of a fragment of tissue for diagnosis can be accomplished with the greatest ease, least trauma, and utmost safety by means of the cutting-current biopsy electrode, which sterilizes and seals lymphatics as it cuts.

Under a limited set of circumstances, adult radioresistant tumors ofttimes react favorably to radiation. For example, carcinoma of the lip, composed, as it usually is, of adult, highly differentiated cells, responds mainly because of its favorable anatomical situation. The lesion can be irradiated from three surfaces, thus enabling an adequate and uniform dose to cause a complete sterilization of the tumor, provided the lesion is not

too extensive. With the exception of such a limited group, electrosurgery constitutes the logical therapeutic procedure in the treatment of adult, radioresistant tumors.

Three important conditions render a radioresistant lesion unsuitable for radiation therapy: (1) Inaccessibility; (2) infection; (3) extensive disease.

Extensive radioresistant lesions are frequently unsuitable for radiation therapy mainly because of the impossibility of delivering a uniform and adequate dose to insure a complete destruction of the tumor process. Electrosurgery is not limited by the factor of radioresistance and is less limited by the extent of the disease than is radiation.

The importance of concentrating the radiation of a tumor into a brief interval in order to prevent the development of radio-immunity has been emphasized by the French school. Unfortunately this principle has not been universally appreciated. Acquired radio-immunity as a result of small, repeated doses is often encountered. In the treatment of this group of cases, electrosurgery offers the best method of attack.

Infection constitutes one of the most formidable barriers to radiation therapy—once the element of infection is introduced, the response of a tumor to radiation is immediately hampered and the entire situation becomes complicated. Electrosurgery is a destructive and sterilizing process and is particularly adapted to the treatment of infected tumors.

Frequently a patient is seen, who, though suffering from an extensive malignant growth, yet has remained in good general condition, a clinical fact which of itself is evidence of the presence of a low grade, malignant process. Such a patient, though considered inoperable by scalpel surgery on account of the danger of metastasis and the likelihood of recurrence, nevertheless may be offered a fair prognosis by newer methods. When a lesion is both advanced and radioresistant, neither scalpel nor radiation has much to offer. To this rather large group of cases electrosurgery is peculiarly adapted. Through the surgical application of endogenous heat it is possible to destroy and remove extensive lesions with a degree of protection not provided by any other agent. Thus it would appear that the scalpel is being out-moded by modern methods in the treatment of cancer.

In an informing article entitled "The Relative Values of Surgery and Radiotherapy," Dr. W. J. Mayo points out that only particles of molecular size, such as sugar, the amino-acids, and other crystalloids are absorbed directly into the capillaries, while colloids and large particles are picked up by the lymphatics. Dr. Mayo says, "Bacteria and malignant cells do not pass directly into the capillaries but are carried by phagocytes into the lymphatics, which are a closed system of vessels." To emphasize this fact is to emphasize the danger of dissemination which lies in the scalpel's severance of lymphatics and the advantage which inheres in a method that seals instead of severs.

This quality of protection against mechanical implantation of malignant cells is inherent in a proper technic of electrosurgery whereby we have two distinct procedures; first, to excise the lesion with the endotherm knife or cutting current, and, second, to destroy the lesion *in situ*, first by desiccation or coagulation and then immediately to remove it as dead tissue instead of as viable cells.

In the treatment of those radioresistant lesions that are notoriously prone to recur after scalpel excision, such as squamous carcinoma, neurogenic sarcoma, and melanoma, electrosurgery has won for itself a unique place. Too often is this method fallaciously regarded as a means of last resort only. Although usually only a single treatment should be necessary, electrosurgery can be used in repeated treatments without prejudice to the patient. There is no injury to

the surrounding tissues for the reason that electrosurgery is at all times under the control of the operator, who administers just as much or just as little as his experience has taught him is proper.

Malignant growths in cavities such as the antrum, larynx, bladder, et cetera, may be made accessible by incision with the endotherm knife and then desiccated or coagulated as may be indicated.

When newer methods are adopted and every general hospital shall have a cancer department, in charge of a cancer specialist, trained to study the pathology of each case upon admission and able to direct the proper form of therapy for that particular case, then rapid progress in the treatment of cancer will be made.

CONCLUSIONS

1. Adult, highly differentiated, radioresistant tumors—with certain exceptions—constitute a large group of neoplasms which are unsuitable for radiation therapy. These lesions are particularly suitable for treatment by electrosurgery.

2. Two other factors which limit the effectiveness of radiation therapy are:

(a) Extensive disease,

(b) Infection.

Electrosurgery minimizes the importance of both of these factors.

3. Whenever it is necessary to remove tumor tissue, electrosurgery offers all of the scalpel's advantages with the added protection of sterilized tissues and sealed lymphatics.

4. By means of the cutting-current biopsy electrode and the rapid frozen section method the radiosensitivity or the radioresistance of a tumor can be determined, in most cases, before treatment is begun. Thus it is possible to avoid the too frequent mistake of excising radiosensitive tumors by the scalpel and over-treating radioresistant lesions with persistent radiation.

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DISCUSSION

Dr. Wyeth (closing): There are some things which can be done both by irradiation and electrosurgery: there are other conditions which respond better to radiation than to electrosurgery; but still others do not respond so well to radiation and are better treated by electrosurgery. We now have a means of determining the indicated method before beginning treatment. It is one of the most important factors in the treatment of cancer to determine, before undertaking therapy, the kind of lesion with which we have to deal.

THREE IMPORTANT POINTS IN THE X-RAY TREATMENT OF MYELOGENOUS LEUKEMIA: THE SPONTANEOUS LEUKOCYTIC CRISES; THE REVERSAL OF THE SENSITIVITY RATIO OF RED AND WHITE CELLS; THE SURVIVAL OF IRRADIATED MYELOCYTES

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AMONG the many questions concerning the radiotherapy of leukemias, the one most often discussed is the problem of the mechanism of the action of the rays in these diseases. It is a point which in the main seems to have been settled, for by admitting a destructive action of roentgen rays the mechanism of the diminution of the white cells which can be obtained with roentgentherapy seems obvious.

This destructive effect, according to the researches carried out, can be explained in either of two ways:

(a) by a direct action on the hematopoietic system.

(b) by an indirect action by means of a leukotoxin liberated by the destructive action, or by protein decomposition products, which act on the blood-forming system and on the circulating blood.

Studies on the elimination of uric acid, which seem to show a parallelism between excretion of this substance and destruction of leukocytes, appear to confirm the theory that the fundamental effect of the rays is a destruction (direct or indirect) of leukocytes; and it is only recently that doubts seem to have blossomed forth, doubts which for a long time I have held about the mechanism of this effect.

In regard to the direct action, it seems to me as well as to many others (Siciliano, Micheli, Italian Congress of Radiology, 1930) that this idea should be subordinate to that of an indirect effect, and, on the other hand, this indirect action will explain more acceptably facts which a destructive action does not account for.

The contrasting facts may be summarized in the main as follows:

(1) It is difficult to imagine that only destruction can bring about equilibrium in the blood. It is necessary to think that X-rays inhibit at the same time the hyperfunction of the bone marrow or at least neutralize those factors which are augmented by the abnormal proliferation (Micheli).

(2) It is difficult to think that improvement may result by striking only at the leukemic foci in the spleen, because it is known that the lesion is a generalized one and that the bone marrow is fundamentally involved. It is difficult to think that the effects of irradiating the spleen alone will be equal to those of treating both the spleen and the bone marrow. It is clear that the fundamental action must be an indirect effect from a distant place. But this effect does not consist so much in a destructive action as in an excitation of the processes of defense, especially of those processes which regulate the production and maturation of the leukocytes, while at the same time the erythropoietic system is encouraged to take on its proper function.

(3) It is difficult to believe that the mechanism of the action of radiation consists essentially in destruction when we know improvement results not only from lightly filtered rays but even from the borderline rays (Grenzstrahlen) which do not penetrate beyond the skin. Then, too, according

to the investigations of Teschendorf there exists an undoubted relationship between blood changes and the size of the area irradiated. According to Maragliano it is not possible to ignore changes taking place in the skin, the effects of which are unknown at present.

(4) It would be difficult to think of a destructive mechanism of roentgentherapy which would be of any advantage in aleukemic forms.

(5) There is no parallelism between destruction of leukocytes and elimination of uric acid. Many authors, even though they did not specifically investigate this point, state that when the number of leukocytes in the circulation is increased (either spontaneously or through some stimulus) there must necessarily be a corresponding destruction of white blood cells from which results an increased excretion of uric acid. But one may raise the objection that an increased elimination of uric acid can take place when leukopenia is present.

These considerations, and others, particularly of those benefits which X-ray may produce in aleukemic forms, make us believe that the fundamental action of X-rays in leukemia is not one of destruction. And even though one cannot deny that a certain destructive process does exist, at least initially, so that the reduction in the number of white cells which occurs from irradiation is established as the most apparent phenomenon, yet it is not the fundamental one in the mechanism of improvement.

Now this destruction, as can be shown in the curves I have drawn which I showed at the Italian Congress of Radiology at Turin in 1930, occurs in crises: crises which are analogous to those occurring in the spontaneous leukolytic crises which occur in all leukemias, both acute and chronic (where naturally the phenomenon is more evident), representing a natural process of reduction of the excess of leukocytes in the circulation. The difference between the spontaneous crises and those which occur after treatment is that the latter are provoked, that is to say, the X-rays provoke a leukocytic increase provoking the crisis of destruction which follows.

The mechanism of action of X-rays, therefore, appears in a new light, because basically what happens in leukemia is not different from what takes place normally with the addition of these crises. Thus we get the explanation of that oscillating period which occurs constantly in the treatment of leukemias which all authors have observed, but never analyzed. Moreover, according to the way in which these leukocytic crises are produced in roentgentherapy, the first crisis is followed by others of less intensity until the number of leukocytes is decreased to the desired level. It can be shown by a single irradiation, and even one of moderate intensity, that the roentgen rays initiate less intense successive crises. This is validated by the fact that the action of X-rays continues for some time, as if the irradiation provokes progressive reductions which continue for several weeks.

It is easy to demonstrate these leukocytic crises in a case of leukemia by taking a daily white count, but if the counts are infrequent the curve is stationary at some certain number or seems to have a progressive course without jumps.

If they are made daily it is easily demonstrable that the count is really not stationary or progressing regularly, but that the curve of the leukocyte count is irregular, interrupted by sudden rises and falls in the number of leukocytes, but these irregularities are missed because of infrequent observations.

These numerical variations (accompanied naturally by qualitative changes) are specially evident in the acute and subacute forms, as was reported by Washburn (1921), Frontali (1928), and more recently by Gosio (1929). It is interesting to recall here a case, studied by Gosio, of a patient twenty-nine years old who had lymphatic

leukemia at the Clinica Medica at Rome. The patient was followed for twenty-eight days until his death: after a marked rise in the leukocytes, a sudden crisis brought the white cells from 250,000 to 100,000 in four hours. Another interesting case is one of subacute lymphatic leukemia of about three months' duration in a youth that Gosio followed till death. Between the thirty-first of May and the second of June, the leukocytes dropped from 150,000 to 80,000. On June 7, 1927, the white cells numbered 98,000; on the ninth they had dropped to 11,000; on the thirteenth they had risen to 21,000; on the fifteenth to 34,000; on the seventeenth to 46,000; on the twentieth to 48,000; on the twenty-third to 95,000; on the twenty-fifth to 130,000; on the twenty-seventh to 180,000; on the twenty-eighth a sudden spontaneous decrease began, and the leukocytes dropped to 75,000; on the twenty-ninth to 30,000; on July 2 to 26,000; on the fourth to 15,000. In forty-eight hours there had been a destruction of 150,000 leukocytes (Curve I).

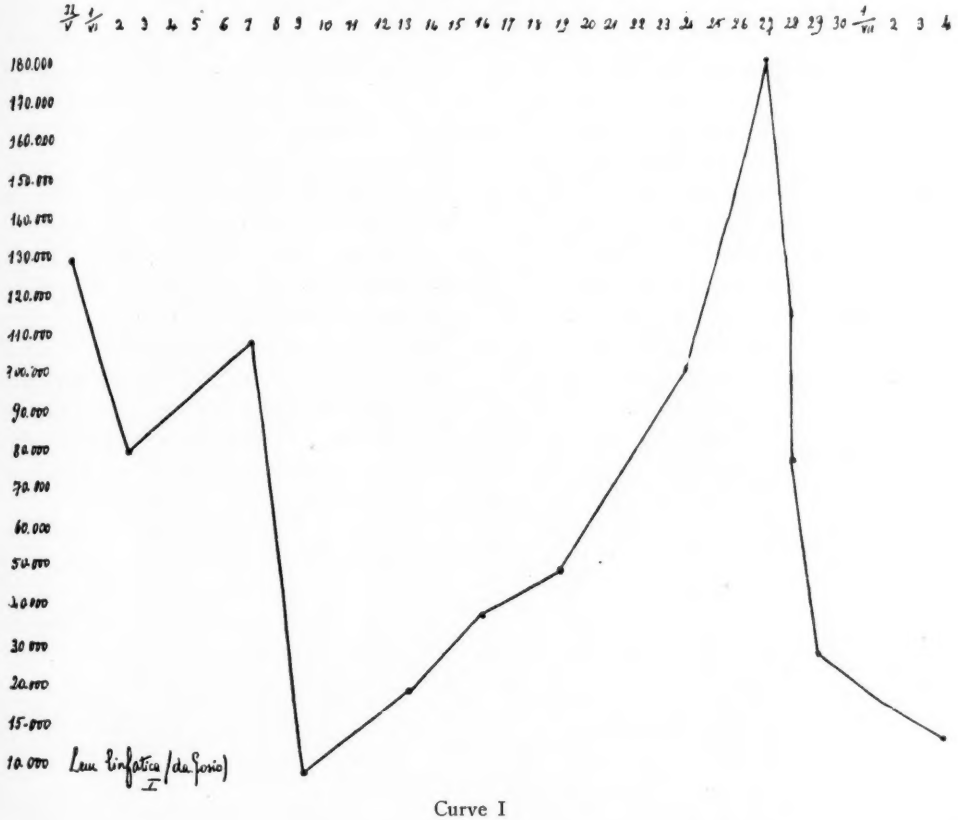
The phase which precedes lysis is characterized by a deterioration of the general condition, increase of fever, swelling of the nodes and of the spleen. Lysis is characterized by a fall of fever, sweating, reduction in the size of the nodes and of the spleen, and an improvement in the general condition. A demonstration of lysis is given by the serum, which, instead of its transparent yellowish color, has a white, milky appearance; by the free granules in the serum; by the broken-up elements in the smears and in the fixed preparations; by the demonstration by the ultramicroscope (Gosio) of cellular changes; the protoplasmic edge is wavy; the cell is misshapen; there is separation of granules both in blood freshly drawn and in blood left in the incubator in contact with lytic serum taken in the crisis.

These same leukolytic crises may be observed — naturally less marked — also in chronic forms of leukemia, both lymphatic and myelogenous, especially when the number of white cells is sufficiently high. Parrisius recognized that at times there are marked oscillations in the number of white cells, but he says they are due to errors in counting, these being the greater the higher is the number of cells. On the contrary, it is a question of daily variations, of spontaneous crises which are accompanied by qualitative changes, consisting mainly in destruction of immature cells in the circulation, so that the mature cells are in greater number, and cells of the granulocytic series get into the circulation.

Those who have studied spontaneous leukolytic crises in leukemia are inclined to place great weight, as causative agents of the crises, on oxidizing ferments from the granules of the polynuclear cells, granules which maintain their activity even outside the cells. It may be these granules, which, having separated from the cells, provoke the crises in leukemia, crises accompanied by a fall in temperature, shrinking of the spleen, increased excretion of uric acid, etc. It may be a process similar to that which can be produced in a pulmonitis with leukocytosis by administration of extracts of leukocytes made from the patient's own blood; there is produced a hemoclastic crisis with lowering of temperature and the serum may even *in vitro* dissolve the white blood cells.

If we study the events which take place in leukemia after radiation we can easily find that the crises that occur are similar in every way to the spontaneous leukolytic crises. The rays induce a leukolytic surge, and this initial increase in number is followed by a more or less sudden drop in these cells; the crises that follow are less intense. Coincidental with the increase in white cells are malaise, fever, deterioration of the general condition, swelling of the spleen and nodes. In the lytic phase, when the number of leukocytes is decreasing, there is fall of temperature, improvement in the general condition, shrinkage of the spleen and of the en-

larged nodes. In a word, there is a clinical picture analogous to that occurring in the spontaneous crises, with all the signs of hemoclastic shock. The single difference is that the provocation of the crises by X-rays follows an initial increase in the number of cells.



Curve I

The curves which I have shown are sufficiently conclusive. Moreover, in the crises produced by X-rays it is possible to show (as Gosio showed in the spontaneous crises) an increase in the fragility of the leukocytes and the separating out of granules when the serum is taken at the period of greatest lysis. When white cells and lytic serum are mixed, it is to be noted that the reaction takes place only with the white cells of the patient; this shows that we are dealing with an autolytic power of the serum, which is lost by heating to 56 to 60 degrees.

II

The establishment of these leukolytic crises, which are produced by radiation and are perfectly analogous to those occurring spontaneously, reduces to a simple secondary incident the question of the destructive action of the rays. The real mechanism of their regulatory action on medullary hyperfunction is still to be studied.

But this fact allows us

(1) to recognize the analogy in the changes that occur after radiation in the blood, both in normal and leukemic patients. Investigations made on the circulating blood, both *in vivo* and *in vitro,* have shown for

the greater part a radioresistance of the elements of the blood; the changes which take place in the normal blood after irradiation may better be interpreted, therefore, not as variations in destruction but as changes in peripheral distribution, and only to a slight extent as direct changes in the lymphatic tissue or as decreased production by the irradiated tissues of the blood-forming system.

In the leukemic patient, the leukocytosis produced by irradiation provokes a sudden leukocytic crisis which not only is repeated by each irradiation, but also in its turn provokes secondary crises, making it appear that the effectivity of X-rays is prolonged, sometimes for as much as several weeks, a point which Krause has brought up.

(2) It makes superfluous all discussion of the existence or non-existence of a leukotoxin; the ferments liberated in the spontaneous leukolytic crises have an autolytic action on the young and immature leukocytes of the patient. In leukemia, after irradiation, the same process is repeated as that which takes place spontaneously, without its being necessary to have any leukotoxin in the circulation to destroy immature leukocytes, but not the young, undifferentiated cells which give rise to the erythrocytes, which seem actually to be increased. Whenever it seems necessary to accept the hypothesis of a leukotoxin (a hypothesis which the demonstration of a leukolytic crisis renders quite superfluous), it should be possible to demonstrate an attenuation of the leukocytic elements in the circulation, a demonstration which still remains to be made.

Lavédan and Lacassagne were able to demonstrate no changes in the resistivity of the leukocytes after irradiation in their investigations on the survival of leukocytes in which they used white cells in droplet preparations of cells in physiologic solution.

Gosio, in his studies of leukemia, was unable to find signs of cellular debility in comparison with his controls in experiments in which he used many methods: methods of hypotonic solution, method of Achard, with solutions of urea, method of the survival of leukocytes, conservative power of normal serum for the leukocytes of the patient, etc.

In two cases of leukemia in good condition, repeating the investigations of Lusena, with the pipette of Forti, I have not been able to find any changes in the survival of leukocytes or degenerative phenomena in the leukocytes, either before irradiation (as Gosio found) or after it.

It should be noted that Lusena in two cases of myelogenous leukemia found that leukocytes have a short period of survival (forty-eight hours instead of eight days) but the observations of Lusena were made in the terminal stages of the disease. When death is approaching, the already shortened period of survival is decreased even more. (Policlin. Sez. prat., 1928 and 1929.)

At first glance, these observations, which establish a complete absence of any cellular debility after radiation, may seem in contrast with the fact that in the crises the serum has a lytic effect on the white cells, but the contrast is only apparent because: (1) from the investigations of Gosio and myself the lysis seems effective on non-debilitated white cells; (2) the technics which test the lytic power of the serum and the leukocytic resistance are not similar: the lytic power of the serum is tested in a thermostat at 38 degrees by mixing lytic serum and leukocytes (and after taking the serum at the period of maximum lysis and the cells of the same patient): the resistivity of the leukocytes is tested in a drop, with the addition of physiologic solution, as was done by Lacassagne and Lavédan in their experiments.

Since these technics are not similar, the results of those experiments on the lytic power of serum of leukemic patients after irradiation are not comparable without tak-

ing into account the period of lysis or the prelytic period, an objection which explains in part

(a) the positive results of Hoffmann (1905) who obtained *in vitro* a leukocytosis by mixing the blood of a leukemic patient with blood of an irradiated patient; the positive results of Ambrosio (1910), who obtained cellular destruction by injecting into leukemic patients serum which had been irradiated with X-rays; the positive results of De Luca (1907), who confirmed *in vivo* the results of Hoffmann; the positive results of Curschmann and Gauss, who obtained a leukopenia by injecting the serum of an irradiated leukemic patient;

(b) and, on the other hand, the negative results of Klieneberger and Zoeppritz, who denied any leukolytic reaction of the serum of irradiated leukemic patients (the lytic power is in fact exclusively autolytic). To those who hold the objection that the leukolysis which is found in the thermostat after mixing white cells and serum is to be interpreted as a result of digestion by proteolytic ferments, one may answer in rebuttal that, if the experiments are carried out with good technic and with a fixed temperature, it will be found that leukolysis takes place only when the serum is obtained at the period of greatest lysis, and only in the cells of the patient (an exclusively autolytic effect). Probably the result of many of the experiments reported may need to be revised, and the leukopenia produced by injecting radiated serum is not the result of those substances produced in the serum by radiation, but to some normally present in it.

III

In general, with the diminution of the white cells and improvement in the general condition, there occurs an improvement in the hemoglobin value and of the red cells. These may occur on the contrary when the general condition is getting worse, or when there are hemorrhagic phenomena present, for every irradiation (even one light enough to cause a slight decrease of the leukocytes) is accompanied by hemorrhagic phenomena or accentuates them if they are already present. This fact, that shortest roentgen treatments incapable of producing changes in the leukocytes may produce these hemorrhagic changes, makes one think that there is a reversal of the sensitivity of the red and white cells and only a destruction of red cells.

Now, it has never been possible to demonstrate in a single case a debilitation of red cells, the investigations of the presence of an iso- or heterohemolysin have been negative; the investigations of Sforza on resistivity before and after radiation in leukemia were negative in that he found no essential changes in it; the investigations on hemoglobin changes have been negative.

It is clear, therefore, that we should seek elsewhere the explanation of the phenomena; and I think we ought to take into account two facts:

(1) of the changes which take place after irradiation, deficiency of platelets, hemorrhagic phenomena, and especially of the relationship between the activity of the splenic and reticulo-endothelial system and lysis of the erythrocytes and platelets;

(2) of the importance of the "capillary" factor in stabilizing the hemorrhagic phenomena. The capillaries are a factor still to be studied, but still it is certain that they may be changed by the action of substances liberated by radiation which in the circulation may produce changes which may be those of hemoclastic shock.

I think that the foregoing considerations have a practical as well as a theoretical value, because all the efforts of both the clinician and the radiologist are devoted to the cure of the patient. In the radiotherapy of leukemia there is much to be done in perfecting our technic and in investigating obscure problems so that as a result our patients may continue in good condition for a long time.

THE TRAINING OF X-RAY TECHNICIANS[1]

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THIRTY years ago it required the combined efforts of a professional photographer, a good electrician, and a trained physicist to produce satisfactory roentgenograms; and the three working together could not produce even diagnostic plates consistently.

The improvement and simplification of X-ray apparatus, the Coolidge tube and duplitized film with standard factors of development, have so simplified the technical end of roentgenology that a person can be taught in a few hours to make X-ray exposures and to develop films. However, the acquiring of a working knowledge of anatomy, a satisfactory medical vocabulary, familiarity with the ordinary nursing procedures, and practical experience are about as difficult of acquisition as they were in 1900.

Is it desirable to employ trained technicians in X-ray work, or shall we use those who know only enough to push a lever when a bell rings? Do roentgenologists want a few robots that buzz for the "big boss" when the filament does not light or some minor adjustment is not made; or do they want intelligent, trained assistants?

The first step in the training of X-ray technicians is the selection of satisfactory students, and this selection often proves to be the most difficult single factor. The usual procedure at the Colorado General Hospital is to have a personal interview with each applicant. Only women who are at least high school graduates are even considered for acceptance. They are asked the routine questions as to their social status—married or single, widowed or divorced, age, educational qualifications, year of graduation from school, what they have done since, and why they wish to take up X-ray work. Answers are written down as they are given. When these are compiled, we occasionally find an applicant graduated from high school at ten years of age, or younger—honesty is one of the requirements for admission to the course. Students have been accepted as young as sixteen and as old as forty-six, but most of them have been in the early twenties. If the personal interview is satisfactory, the young woman is advised to make a written application. These applications are kept on file and, when a vacancy occurs, are examined and the best one is selected. Five girls are kept in training; every two or three months one completes the course, at which time a new student is received. The girl selected is given a mental test at the Colorado Psychopathic Hospital and the I.Q. (intelligence quotient) must be 100 or over. A high school diploma means little, but it has been found that the quality of the students' work follows closely their I.Q. rating. When finally accepted the technician-in-training signs and is given a signed contract.

This contract provides:

1. A course of training for twelve full calendar months.
2. That for services rendered students are to receive instruction, experience, and training in the X-ray Department.
3. That in addition they are entitled to lunches and laundry of white uniforms. No salary.
4. That they must observe all hospital regulations.
5. That on the completion of the course they will be granted a certificate.
6. That this agreement may be cancelled upon one week's notice.

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1–5, 1930.

Studies consist of: (1) Anatomy; (2) Physics of Electricity; (3) Dark Room Technic; (4) X-ray Technic; (5) A hundred miscellaneous topics. To insure regular, systematic study and to avoid "cramming" at the end of long intervals, tests are given twice monthly.

In Anatomy, "A Text-book of Anatomy and Physiology," by Williams, is used. This is also the text for the School of Nursing and occasionally the classes are combined. In osteology, the students study actual bones and the articulated skeleton. The close association of the hospitals with the School of Medicine has enabled the students, at times, to receive their instruction in this subject from the Department of Anatomy.

The Physics of Electricity is required because it is impossible to give an intelligent explanation of X-ray apparatus without a knowledge of the fundamentals of magnetism and electricity. A high school physics text, usually Millikan and Gale, is used.

For Dark Room and X-ray Technic, the text used is "Roentgenographic Technic" by Rhinehart (1), with Jerman (2), U. S. Army Manual (3), MacKee (4), Christie (5), Enfield (6), and others for reference.

The hundred topics, which deal with miscellaneous X-ray and allied subjects, are revised every year. Each student recites on a major subject and on ten of these one hundred topics each month. The following is the grade card of a student who entered in March, 1930:

	Subjects	Topics
April	All bones	1-10
May	Positioning	11-20
June	Magnetism and static electricity	21-30
July	Electricity in motion	31-40
August	Induced currents	41-50
September	Upper and lower extremities	51-60
October	Torso	61-70
November	Trouble-hunting	71-80
December	Skull	81-90
January	Soft tissues	91-100
February	Final	

Since all of the technical work of the department is done by the students, they receive a full year of actual, practical X-ray training. Over 400 patients are examined in the X-ray department monthly. These come from the wards and Out-patient Department of the Colorado General Hospital and the Colorado Psychopathic Hospital.

The practical training is divided into five services, with rotation every two weeks. The following is a sketch of the duties in the different divisions:

1. *Office.*—Keep all records, take dictation, type reports, place films on viewing boxes and stereoscope, and extend other courtesies to the house and visiting staffs.

2. *Dark Room.*—Load cassettes, develop all films, label envelopes, and place proper films in them.

3. *History-taking.*—Secure brief history of patient and type on record card, arrange for examinations as to time and preparation, make out cashier slips and record X-ray numbers for the examinations.

4. *Junior Clinic.*—Assist at fluoroscopic examinations, prepare opaque meals and enemas, watch and time treatments, keep clinic rooms in order.

5. *Senior Clinic.*—Make radiographic exposures. Rapid, intermediate, and slow technics are taught. The radiographic effects of peak kilovoltage, milliamperes, distance, and time are emphasized, as well as the causes of distortion, detail, contrast, and density. Standard positioning is insisted upon throughout the year. Electrical dangers, X-ray dangers, proper protection from high voltage electricity, and methods of protecting patients, visitors, and operators from excessive exposure to primary and secondary X-rays are constantly emphasized.

Class sessions are held at least once a week at which student questions are discussed. These are often distributed over the entire range of X-ray and allied subjects. Vocabularies are reviewed, and quizzes on the spelling and meaning of words given in the nurses' anatomy text, supplemented by

other medical terms in common use, are held.

Aside from the technical training, there is instruction in medical etiquette. Before entering the course, few students have had much contact with doctors, nurses, or patients, so that they must be taught how to greet the visiting staff, to handle and care for patients, and to talk to relatives. It is important to impress upon the students that they must not make public gossip of patients' histories, and that the relation of patient and technician is confidential. Securing wholehearted co-operation and loyalty to the department is one of the crucial tests of the success of the course.

Treatment and diagnosis are not taught.

Each student signs the following agreement, which is virtually that of the American Registry of Radiological Technicians: "I hereby agree to work at all times under direct medical supervision (graduates of regular schools of medicine) and under no circumstances to give out written or oral diagnosis, or work independently, whether in any private office, hospital, or institutional laboratory."

In brief, the course attempts to teach young women the essentials of gross anatomy, to give them a fair medical vocabulary, and to train them in X-ray technic so that they can produce the type of roentgenograph which the doctor who employs them may desire. It gives a few intelligent girls a training, the educational value of which is more than equal to a year in college.

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DISCUSSION

Dr. D. A. Rhinehart (Little Rock, Ark.): We all enjoy an unusual paper such as Dr. Harvey has presented. His method of selecting students by their educational qualifications and intelligence quotient is of particular interest. Since technic is as much motor as mental, I wonder if he also pays attention to the manual dexterity of the applicants? Usually mental and manual agility go together, but occasionally we see a person of good intellect who is very clumsy. I remember one student of this type who mastered his chemistry assignments and wrecked the apparatus in the laboratory.

The course offered by Dr. Harvey covers in an admirable manner instruction in roentgenographic technic from both the theoretic and practical aspects. I am pleased to note that it includes conduct in the laboratory. Conduct reflects personality; good conduct and a pleasing personality prevent complaints by patients for imaginary or real slights or indignities, thus maintaining the good reputation of the laboratory. Conduct also includes silence about happenings in the laboratory—a gossipy assistant can cause no end of trouble. Each of my assistants knows that transmitting information about patients' affairs outside the laboratory is tantamount to handing in her resignation.

Dr. Harvey uses considerable foresight in having each of his students sign an agreement not to attempt diagnoses and not to work except under the supervision of a licensed physician. Many physicians do not fully realize that roentgenology is a highly specialized and technical part of the practice of medicine. Some time ago a prominent physician, an ex-president of the state society in my state, asked me how long it would take for me to teach his nurse to interpret X-ray films. I replied that it would take about two years longer than it would take me to make her a doctor of medicine. He saw the point.

MEDICAL (OR OTHER) SOCIETIES MAY GOVERN THEMSELVES

THEY MAY DISCIPLINE THEIR OWN MEMBERS

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., CHICAGO

I am more than reasonably sure that all of the readers of RADIOLOGY can remember when some members of a society (medical or lay) have taken refuge in the courts against action of that society which was making an effort to rid itself of the plaintiff in the suit.

This sort of a lawsuit usually arises out of what is claimed to be unjust feeling, jealousy, discrimination, or other true or imaginary causes, but the fact remains that these suits continue to be started, and that a society has the right to dispense with or eliminate any of its members, if such action is in accordance with its own organic law, and not in conflict with the laws of the State in which the society is incorporated. It is a most significant and important fact that no court of last resort in this country has ever decided to the contrary.

In medical organizations most of these eliminations, or, as we usually call them, expulsions, occur because of infractions of the ethical code, and always occur after a trial or hearing of evidence, and due consideration of such evidence as is presented by those making the charges and usually by the defendant in the case.

Many organizations relegate the trial of such affairs to a committee, board, commission, or council, and some of them give these quasi-judicial bodies power and authority to act upon and dispense punishment in these matters and report their action to the parent organization.

Courts will not so interfere with the internal affairs of an incorporated organization as to settle disputes among its own members, or questions of discipline, policy, or internal government of the organization, as long as this government is administered in conformity with its own laws and the laws of the State where it is incorporated, and if no property or civil rights are invaded.

On the other hand, the proceedings of such a society or association are subject to judicial review where there has been proved fraud, bad faith, or oppression, or where civil or property rights are involved or any proceedings in violation of the society's or association's own laws, or the laws of the State where the same is incorporated; but even in these cases the courts will not take jurisdiction unless the complaining members have exhausted all remedies. Decisions of courts of last resort upon the rights of medical societies to expel members, and similar questions, are numerous. Among these may be mentioned: Irvin *vs.* Luria *et al.* (La.), 126 So.R. 669; Rabb *vs.* Trevelyan (La.), 122-174, 47 So.R. 445; Braden *vs.* Lewis (La.), 88 So.R. 197, 148 La. 920.

REPORTS OF CASES INVOLVING RADIOLOGICAL MATTERS[1]

Evidence: Medical Books (Percoco's Case (Mass.), 173 N.E. 515).—Opinions on medical matters or on any other subject are not admissible in evidence except by the testimony under oath of a person skilled therein. Statements contained in medical or scientific books cannot be used in evidence, and counsel may not read to the jury from such books. To permit such evidence would be to admit in evidence the statement made out of court by a person not subject to cross-examination. This rule is subject to

[1]Reprinted by permission from the *Journal of the American Medical Association.*

an exception when a witness refers to a treatise as corroborating his testimony. The treatise may then be read to prove it does not show such corroboration.

Roentgen Injury Following Two Years' Treatment (Berg vs. Willett (Iowa), 232 N.W.R. 821).—Roentgen treatments were administered by the appellee, a physician, for the cure of ringworm on the left hand of the appellant. The first treatment was administered, Jan. 11, 1926. For the first two or three months, according to the patient, treatments were administered twice a week. Thereafter, they were administered at irregular and considerably shorter intervals. The patient claimed that he received in the aggregate sixty treatments. The physician's record and books of account, however, showed entries of only nineteen treatments, some of which were apparently applied to the right hand. In June, 1928, more than two years after the first treatment, the patient observed an unusual condition of his hand. This, he claimed, the physician at that time admitted was due to a burn. In a suit instituted by the patient, the trial court directed a verdict in favor of the physician. The patient thereupon appealed to the Supreme Court of Iowa, where the judgment of the trial court was reversed.

It is and must be the rule, said the Supreme Court, that while the result alone is not in itself evidence of negligence, it may be considered, together with other facts and circumstances disclosed by the evidence, in determining whether or not it is attributable to negligence or want of skill. Whether the rule of *res ipsa loquitur* has or has not been adopted in Iowa, however, the court regarded it as unnecessary to determine, because the record in this case was barren of any expert or other testimony that could support the application of the rule to the state of facts disclosed. The evidence shows, said the court, that some persons possess idiosyncrasies that make them peculiarly susceptible to roentgen rays. Perhaps, added the court, it is not inaccurate to say that the X-ray machine also apparently possesses idiosyncrasies, which are occasionally manifested by undesirable results even when the greatest care and skill are employed in its use. The expert witnesses agreed that the presence of personal idiosyncrasies can be determined only by the administration of a treatment, in applying which great care must be used. In the present case, the jury might well have found from the evidence that the patient possessed no idiosyncrasy to roentgen rays. The case turned, therefore, on whether there was evidence that would have justified the jury in finding that the injury complained of by the patient was the proximate result of the physician's negligence or unskillfulness.

The evidence was ample to show that a patient may become susceptible to roentgen rays if treatments are administered too frequently or over too long a period of time. Under such circumstances, the condition of which the patient now complains or complained may follow. There was no evidence to show that the X-ray machine was negligently manipulated or that any particular application was in itself harmful. The jury might have found, however, said the court, that the physician was negligent in applying roentgen rays to his patient's hand too frequently and perhaps over too long a period of time, the result being what is known as a cumulative dosage or over-dosage. The experts advanced no other theory that would explain the result that followed the treatment in this case, except the possibility that the burn might be attributable to some cause which could not have been known or anticipated in advance by the physician. All of the expert witnesses agreed that much must necessarily be left to the judgment of the physician.

Sufficient facts appeared in the record, the Supreme Court concluded, to have enabled the jury, without undue or unnecessary speculation, to find that the physician was guilty of negligence or unskillfulness, resulting proximately in the injury complained of by his patient. The patient was not required to produce evidence so conclusive as to exclude every possible hypothesis except the hypothesis that the physician was negligent or unskillful. The patient made out a *prima facie* case of negligence or unskillfulness and the issue therefore should have been submitted to the jury.

Liability of Partners for Negligence of Employee Physician (Fellow Employee) Not Liable for Technician's Negligence (Wemmett vs. Mount (Ore.), 292 P.R. 93).—Dr Hugh, Dr. Guy, and Dr. Frank Mount were practising medicine as partners. Dr. Albert Mount and a Miss Lynch were employed by them. The patient came to the partners' office for treatment and was referred to Dr. Albert Mount. He sent her to Miss Lynch, who undertook to treat her on a diathermy machine. Miss Lynch applied one electrode to the patient's loins and another to her abdomen, in direct contact with her body, turned on the electric current and left the room. According to the record, after several minutes the heat generated became so intense that it began to burn the patient. She screamed repeatedly, but no one appeared until after about thirty minutes. Then Miss Lynch rushed into the room, turned off the current and removed the two electrodes, telling the patient that she had forgotten all about her. The burning resulted in three running sores on the patient's abdomen and left two large scars and one small one. She sued the partners and Dr. Albert Mount for malpractice and obtained a verdict. The defendant physicians thereupon appealed to the Supreme Court of Oregon.

The defendants contended that the trial court erred in permitting the patient to testify that Miss Lynch had remarked immediately on returning to the room, "My God, you look as though you are about to pass out, I forgot all about your being here." This testimony, said the Supreme Court, was proper, as the language was a part of the *res gestæ;* when Miss Lynch first entered the room to remove the electrodes, she spoke those words at the very moment that the injury was being inflicted on the plaintiff. Moreover, as was said in the syllabus of *Fredenthal vs. Brown, 52 Ore. 33, 95 P.R. 1114:*

"The acts of an employee within the scope of his employment are the acts of the employer, and the statement of the employee characterizing such acts and constituting a part of them are competent evidence against the employer; but statements of a past transaction made by the employee, and not a part of an act done by him, are not within the scope of the employment, and cannot be admitted in evidence to affect the employer."

This evidence comes within the first part of the rule thus stated.

Further error was assigned by the defendant physicians in the refusal of the trial court to accept their tender of proof, through the direct examination of a medical expert, that the nervous condition of which the plaintiff complained at the trial was the result of goiter and the condition naturally flowing therefrom, and not of the burn. The rule is stated in *17 C. J. 1031:*

"So too defendant has a right to show by medical testimony that the diseased condition probably arose from another source and was not caused by the injury complained of."

It is true, said the court, that the defendants were entitled to have this medical expert's opinion as to what caused the patient's nervousness. The record indicates, however, that this expert had previously

told the jury that in his opinion the burns were not responsible for the patient's nervous condition and that she was not suffering from any permanent injury due to the burns, except the scars. The defendants, therefore, had the benefit of exactly the same evidence as that which they tendered and were not injured by the exclusion of what was in effect a repetition of it.

It was error, further urged the defendants, for the trial court to permit a chiropractor to testify as to approved methods of using a diathermy machine. This chiropractor apparently held a medical degree and had graduated from a college of physiotherapy. It is a general rule, said the Supreme Court, that in a malpractice action a physician is entitled to have his treatment of his patient tested by the rules and principles of the school of medicine to which he belongs, and not by those of some other school. A person professing to follow one system or school of medicine cannot be expected to practise any other, and if he treats a patient with ordinary skill and care in accordance with his system, he is not answerable for bad results. This rule, however, does not exclude the testimony of physicians of other schools or experts in other lines when such testimony bears on a point as to which the principles of the schools do or should concur, such as the dangers incident to the use of roentgen rays or the existence of a condition that should be recognized by any physician. The use of diathermy machines, according to the court's understanding, is common to regular physicians, chiropractors and those who are graduates of schools of physiotherapy. It was not error, therefore, for the trial court to allow the chiropractor to testify.

The defendants also assigned as error the refusal of the trial court to direct a verdict in their favor. It is not the absolute duty of a physician to cure a patient or restore a condition of good health, said the court, nor is he an insurer of the efficacy of his services. The physician undertakes only to exercise that degree of care, skill, diligence and knowledge which is ordinarily possessed by the average of the members of his profession in good standing in the same or similar localities. There was evidence that Miss Lynch, an employee of the defendants, was negligent in applying the electrodes to the patient's body and then leaving the room for thirty minutes, with no one there to look after the patient. Partners in the practice of medicine are all liable for an injury to a patient resulting from a lack of skill or the negligence, in either omission or commission, of any one of the partners within the scope of their partnership business. They are likewise responsible for any injury done to a patient through the want of proper skill and care of their assistant, apprentice, agent or other employee.

The defendants also urged that there was no expert testimony adduced during the trial to show that there was any negligence. As was said in *Ballance vs. Dunnington, 241 Mich. 383, 217 N.W.R. 329, 57 A.L.R. 262:*

"The standard of care, skill, and diligence required of an X-ray operator is not fixed by the *ipse dixit* of an expert, but by the care, skill and diligence ordinarily possessed and exercised by others in the same line of practice and work in similar localities."

The same rules, said the court, apply in the operation of a diathermy machine. A statement, "How . . . did that girl ever burn you like that?" alleged to have been made by Dr. Albert Mount after examining the patient the morning after the burn had been received, and testified to by the patient, was some evidence of negligence in the treatment. Then, too, there was the testimony of the chiropractor. There was sufficient testimony to take the case to the jury.

At an appropriate time, one of the defendants, Dr. Albert Mount, moved the

trial court for a directed verdict in his favor. This motion, said the Supreme Court, should have been granted. There was no evidence tending to show that he was a member of the firm. He was an employee of the partnership. The negligence complained of was not the negligence of Dr. Albert Mount but of another employee of the firm, over whom Dr. Albert Mount is not shown to have had any control. Dr. Albert Mount, although the superior servant of the other defendants, cannot be held liable for the acts of an inferior servant, even though he had authority from the common master to supervise and direct the acts of that inferior servant, unless he actually participated in the wrongful acts complained of.

The defendant physicians requested the trial court to charge the jury, in substance, that if the evidence showed that the physical health or condition of the patient at the time of receiving the treatment was such as to produce any condition of which she complained, without any negligence on the part of the defendants, she could not recover for that condition. The court, however, instructed the jury in effect that the patient could recover only for the pain, suffering and physical disability, if any, that she suffered by reason of the sole negligence of the defendants and without her negligence. This, taken in connection with the entire charge given the jury, does not permit them to find anything for the patient by reason of the condition produced by her general health at the time of receiving the treatment.

For the reasons stated, the judgment of the trial court was reversed as to Dr. Albert Mount and affirmed as to the other defendants.

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EFFECTS ON OFFSPRING OF ROENTGEN IRRADIATION OF GENERATIVE GLANDS[1]

By JONAS BORAK, M.D., Assistant Roentgenologist at the Holzknecht Institute, Vienna

Three periods in the development of the problem of gonad irradiation in relation to hereditary transmission may be distinguished. The first period extends down to the year 1911. The experiments were conducted with frog eggs. The results showed that irradiation of mature germ cells produces abnormalities and leads to the death of the cells in an early embryonic stage. The second period extends from 1911 to 1927. Researches were carried out on rabbits, guinea pigs, and mice, to discover whether or not the irradiation of immature germinal cells exerts an influence on the offspring. The results were absolutely negative. The third period comprises the researches of 1927, at which time Muller reported on the results of his irradiation of *Drosophila*. On this fly, the genetic development of which has been most completely studied, biologic experiments with a view to discovering the effects of irradiation on offspring had been previously made. After discussion of the biology and the anatomy of the organs of reproduction, and consideration of the detailed structure of the cells in *Drosophila*, these experiments will be carefully described. Three irradiation effects on the biologic characters of the offspring have thus far been observed in *Drosophila:* (1) Modification in the exchange of hereditary factors (Mavor, 1923; Muller, 1926); (2) the appearance of so-called exceptional individuals (Mavor, 1923, *et al.*), and the appearance of mutations (Muller, 1927, *et al.*). With reference to (1) and (2), it should be noted that these concern physiologic irradiation effects, (1) being of a phenotypic and (2) of a genotypic nature. As to (3), here it is a question of pathologic effects, which consist in part in an increased mortality (appearance of lethal factors), and in part in a modification of somatic characteristics. The latter changes are of a genotypic nature. Both kinds of mutations are of a recessive type; that is, they do not appear until the third generation of irradiated animals.

These effects of irradiation may then be analyzed from the point of view of whether they are to be ascribed to an influence exerted on immature or on mature cells. All the irradiation effects have this in common, that the changes brought about occur also spontaneously; but after the irradiation they occur more frequently than otherwise.

With reference to the exchange of hereditary factors, it is known that this takes place in the conjugation stage; that is, in the stage immediately preceding the maturity divisions. The appearance of so-called exceptional individuals (which brings about a shifting of the sexes) is ascribed to the nonyielding nature of the sex chromosomes in the stage of reduction division. The fact that mutations, as a rule, appear only in one individual and not simultaneously in several siblings, may be taken as an indication that they originate in the mature germinal cells. The results of irradiation agree absolutely with that assumption. It was found, for example, that all irradiation effects are only of a temporary nature, as they appear only in the offspring that hatch from the irradiated eggs within the first 10 to 14 days. Offspring that develop from eggs laid later no longer show any biologic abnormalities of an hereditary nature. Especially is this true of the lethal and the morphologic muta-

[1]Read at the session of the Wiener Gesellschaft für Röntgenkunde, Vienna, March 3, 1931, under the chairmanship of Professor Haudek; secretary, Dr. Presser.

tions. The number of abnormalities decrease from day to day and still more sharply from week to week, and disappear then in about two weeks. The results of irradiation on *Drosophila* prove, therefore, that the immature germinal cells (oögonia, spermatogonia) cannot be influenced from a biologic and hereditary point of view by roentgen or radium rays. In these respects, the results agree absolutely with the results obtained with mammals.[2]

The reasons why in mammals, in contradistinction to *Drosophila* and frogs, even after the irradiation of mature germinal cells (oöcytes, spermatocytes and their derivatives), no hereditary transmission of biologic effects is apparent may doubtless be explained by the following facts:

1. In female mammals, the reduction division, and thus the formation of mature egg cells, does not take place in the ovary, as is the case with *Drosophila*, but in the tube or in the uterus, and, moreover, only after the impregnation by the spermatozoa. In female mammals, therefore, there can be no injury of the germinal cell as the result of an irradiation but only an injury of the embryo.

2. In the male mammals, the mature spermatozoa, in much the same manner as in *Drosophila*, are formed within the gonad. As the result of an irradiation of a gonad, an appearance of hereditobiologic effects is, therefore, theoretically possible in male mammals; although, to be sure, only when the fertilization takes place a short time after the irradiation. In reality, however, no genetic changes have been found under these circumstances. As the roentgen rays bring about only an increase of spontaneous changes and the mutability varies greatly with the type of animal, the frequency of roentgen mutations in various animals is quite different. In view of the great rarity of mutations in mammals, especially in the higher animals (in man it is doubtful whether mutations occur at all), mutations can scarcely be anticipated in mammals after roentgen irradiation.

[2] *Drosophila melanogaster* is a small fly used extensively in experimental studies on genetics and that is doubtless the one meant here.—H. R. W.

THE PROBABILITY OF HEREDITARY DEFECTS RESULTING IN OFFSPRING FROM OVARIAN IRRADIATIONS

By S. PELLER, M.D.

The quantitative results of the biodynamic effects of roentgen rays on the germinal cells of plants and animals cannot be transferred to man, because (1) the results depend on the structure of the gonads, the process of maturation of the germinal cells, the structure and the number of the chromosomes, and the like, and hence vary with the variety, subspecies, species, and race: (2) the irradiation dose in human therapy is different from that used in experimentation: (3) in man, the results arise from the absence of inbreeding, and (4) man has a long generation span and few descendants, while plants and animals have a much shorter generation span and many descendants.

The dangers with respect to children that result from delayed fertilization, in case, by chance, fecundation of women temporarily sterilized occurs, are under these circumstances so slight that they do not need to be considered. In order to prove this, the most favorable assumptions possible are proposed, namely, monofactorial fixation of the hereditary characters, exclusively morphologic mutations and no lethal factors, all injuries affecting the sum total of characters of a high degree, an undiminished fertility of the women treated—not less than that of the average woman—normal fitness to mate and normal fertility of the descendants, and a frequency of temporary sterilization in excess of what actually occurs. Let us assume that in Vienna, with a population of 1,800,000 (about 1,000,000 women), one hundred

women are temporarily sterilized each year: then in the second generation of women, among 100,000 individuals 0.0295 person at the most might be damaged as to hereditary characters[3]; that is to say, one child in 3,380,169. If the mortality of the children, of the juveniles, and of the persons of productive age of the first generation of women were equal to 0 and all these persons were to be mated, there would be, on the basis of the present birth rate, 188 years required to bring the second generation of women up to 3,380,169 persons. But, in view of the present fertility and the present population of Vienna, a still greater number of years would be required in order to attain that number from the second generation of women. In reality, the prospect is very slight that a single child among the 3.4 million children descended from the second generation of women would be damaged in its development by roentgen rays previously applied to its remote ancestor in the female line.

DISCUSSION

H. Adler, M.D.: It was difficult for me, a gynecologist, to follow the speakers in their detailed accounts of research on hereditary transmission and their presentation from the standpoint of higher mathematics, although Dr. Borak expounded the whole problem very finely and clearly. I noted one thing especially; namely, that both speakers stated very emphatically that the results of animal experiments may not be transferred to man and that the conditions obtaining in flies, mammals, and man are widely divergent. Nevertheless, both speakers based their final deductions with regard to the damaging of germinal cells in man on analogous conditions in animals. It may be that the conditions which obtain in the plant world and the lower animal world are applicable to mammals and to man—an opinion that is held by eminent investigators in the field of heredity—in which case there are damages to the germinal cells also in man; or the conditions in man differ from those obtaining in animals, in which case no analogous deductions may be drawn and all mathematical computations, which are, in point of fact, based on animal experiments, are without practical significance.

A second statement I wish to make is that early injuries following irradiation have actually been observed. That fact is emphasized not only by clinicians but also by eminent investigators on heredity. Concerning the frequency or possibility of late injuries, the views to-day are much divided. To say that such injuries are impossible is certainly not justified in the present state of our knowledge. Bearing in mind the facts that I have just stated, I cannot share the optimism of the last speaker.

(To be concluded in next issue)

[3] "Damaged phenotypically," literally.—H. R. W.

CASE REPORTS

GIANT-CELL TUMOR OF THE PATELLA[1]

By ERNEST KRAFT, M.D., University of Chicago, Chicago, Illinois

This is a case report of a patient, Mrs. J. M., aged 32, who, in 1926, noticed a "catch" in her right knee. Since that time she has observed a slowly increasing swelling of the knee, which, however, has caused her but little inconvenience. In 1930, following a childbirth, the limb became heavier and the flexion of the knee impaired. The patient consulted a physician in July, 1930, at which time the tumor of the knee was lanced, with negative results. The roentgen findings were interpreted as a sarcoma, and a high amputation was advised. During the following six weeks, raw oozing masses grew out of the skin incisions.

The patient was first seen on Sept. 2, 1930, when the tumor presented the appearance illustrated in Figure 1. The roentgen examination revealed the characteristic structures of a benign giant-cell tumor, involving the entire patella and perforating the anterior parts of the osseous shell (Fig. 2).

Fig. 1. Appearance of tumor of patella Sept. 2, 1930. The large, protruding, oozing granulations are the result of exploratory incisions.

[1]The results of work carried out at the Lake View Hospital, Danville, Ill.

Fig. 2. Lateral view of patella Sept. 2, 1930. "Foamy" appearance characteristic of a giant-cell tumor. Soft tumor masses are pushing minute osseous splinters into the superficial areas. Irregular osteoblastic changes and calcium deposits are evident, especially in the lower parts of the tumor.

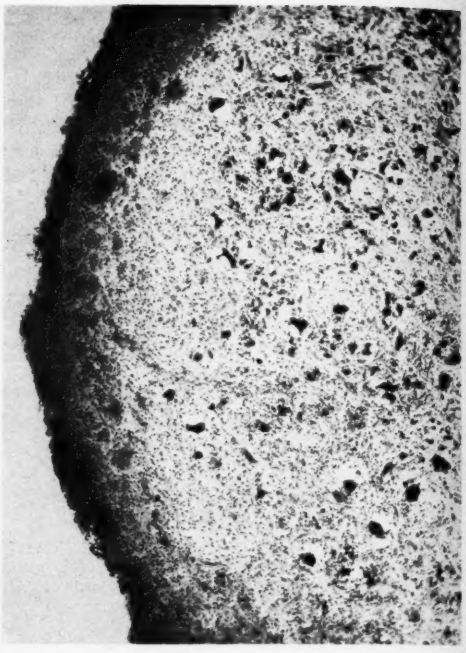

Fig. 3. Frozen section of superficial granulations; × 45. Large amounts of giant cells are spread by an inflamed stroma. The section is covered by a pus membrane. In the deeper portions, giant cells formed the bulk of the tissue.

Biopsy studies of the superficial granulations confirmed the diagnosis (Fig. 3).

A month later, the patient was reexamined. The tumor showed much increase in size (Fig. 4) and presented the external appearance of a highly malignant condition. Roentgen films of the pelvis, chest, and skull did not show any metastases. Only following a severe hemorrhage did the patient enter the hospital on Oct. 13, 1930. X-ray therapy was instituted, which was followed by a remarkable improvement. Two days later, however, a severe hemorrhage occurred which necessitated an emergency operation.

Dr. H. F. Hooker, who kindly permitted the use of his surgical notes, found extremely vascular and friable tissue, with large blood spaces, which could not be controlled by fulguration. He resorted to a curettage and removed crumbly, yellowish-brown masses, which were interspersed by coarse and tender osseous material. The posterior osseous shell was left intact for future regeneration of the patella. The post-operative management resulted in an uneventful recovery.

In December, 1930, some regenerative process was noted in the remnants of the patella (Fig. 5). There was no recurrence observed when the patient was last seen in July, 1931. The case has been approved by the Registry of Bone Sarcoma of the American College of Surgeons and has been given No. 1162 of the Registry Series.

Primary tumors of the patella are very rare. Cole (2) collected 25 cases from the literature in 1925. Among these are 6 cases

with a diagnosis of either myeloid sarcoma, myeloid tumor, or giant-celled sarcoma,

Fig. 4. Roentgen findings Oct. 3, 1930. Rapid expansion of soft tissues in middle and lower portions. Further breaking up and elimination of osseous splinters.

terms synonymous with the modern "giant-cell tumor."

King and Towne (6), Kofmann (7), Inclán (5), Abadie (1), and Giordano (4) reported early cases of giant-cell tumor of the patella. Faltin (3) described a case which closely resembled the writer's personal observation as to the character and final

Fig. 5. Post-operative roentgen appearance of patella December, 1930.

outcome. The benign nature of Faltin's case has been proved by an observation extending over six years.

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URINARY OBSTRUCTION DUE TO A CONGENITAL VALVE IN THE PROSTATIC URETHRA, DEMONSTRATED BY UROSELECTAN

CASE REPORT

By JAMES J. CLARK, M.D., Visiting Roentgenologist, and M. K. BAILEY, M.D., Visiting Urologist, Henrietta Egleston Hospital for Children, Atlanta, Georgia.

The patient, a boy seven years old, was admitted to Henrietta Egleston Hospital for Children, Atlanta, Georgia, on Nov. 4, 1930. His admission diagnosis was chronic cystitis and pyelitis. The following history was obtained from his father, who states the boy has had recurring attacks of kidney and bladder trouble since infancy, lasting for from one or two days to one month, these attacks usually beginning with a chill, followed by fever. He appears to have recovered from a recent acute attack. He has had pain and difficulty on urination and urinary incontinence. Urine is filled with pus.

Physical Examination.—The patient is fairly well developed. There were present chronic tonsilitis, an adherent prepuce, and a firm, slightly tender tumor in the region of the urinary bladder. Urine dripped from the urethra continuously. Otherwise all examinations were negative.

Laboratory Examination.—Blood, red cells 4,800,000; white cells, 10,800; hemoglobin, 58 per cent. Wassermann, nega-

tive. Blood chemistry, non-protein nitrogen, 200 milligrams. Urine, cloudy, alkaline, albumin, two-plus. Microscopic, field flooded with so many pus cells it was impossible to count them.

Nov. 4, 1930, 16 gr. of uroselectan were given intravenously. This examination was difficult to interpret, as indistinct shadows, due, we later found, to the enormous retention of urine in the urinary tract which produced dilution of the uroselectan, showed on the film.

A second examination, using uroselectan, was made November 12, the patient having worn a retention catheter for several days, during which he had drained large quantities of urine.

The roentgenograms, made at 15-, 30-, 45-, and 60-minute intervals, were rather startling. In the kidney areas, there were multiple, large, rounded, opaque shadows, varying in size from one-half to one inch in diameter. They occupied the renal area to the right and left of the spine, but filled twice the space usually occupied by the kidneys. Extending from these shadows toward the bladder were enormous dilated tubes, apparently the ureters, as they connected with a greatly distended bladder. At the conclusion of this examination, the bladder was emptied and refilled with a 10 per cent solution of sodium iodide, its capacity (Fig. 1) being 95 cubic centimeters.

P. S. P. (phenolsulphonephthalein test) from the catheterized bladder showed 35 per cent elimination. Nov. 15, 1930, ureters catheterized; intravenous administration. Left kidney, 10 per cent in 30 minutes; appearance time, 18 minutes; right kidney, appearance time, 20 minutes; total output in 30 minutes, 20 per cent.

Conclusions.—Extensive bilateral hydronephrosis, involving the renal pelvis, major and minor calices. Both kidneys were greatly enlarged. Hydrops of both ureters.

Fig. 1. First study, 20 minutes after injection of uroselectan. Arrows point to large dilated renal calices and ureters.

Marked dilatation of the bladder, with many small trabeculations projecting. Obstruction at urethral vesical orifice.

To confirm these findings, two days later the patient was cystoscoped by one of us (M. K. B.) under a general anesthetic.

Under ether anesthesia, No. 16F infant's scope was introduced into the bladder easily. The bladder was drained with some difficulty, after pressure on various parts of the abdomen. Large flakes of debris could be seen floating in the bladder. A great deal of trabeculation (Fig. 2) was noticed throughout the base of the bladder.

The infant's scope was then removed and No. 18F child's scope introduced. The right ureter was catheterized without difficulty, the catheter passing a distance of 30 cm. before any appreciable obstruction was encountered. It was thought that the

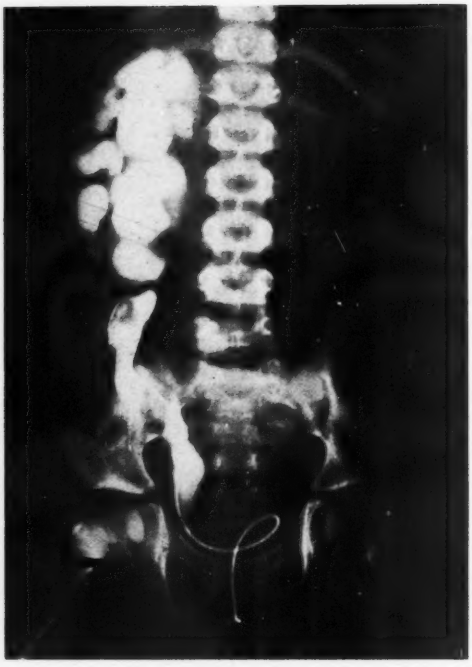

Fig. 2. Left pyelogram and ureterogram. Note dilated ureter, with catheter coiled within. Marked dilatation of ureter, renal pelvis, and calices. It is difficult to determine which part of the shadow is the renal pelvis. Capacity over 100 cubic centimeters.

catheter was coiling up in the ureter. Urine dripped from it continuously, about 40 c.c. being obtained. When centrifuged, about 0.5 cm. of sediment was obtained; on staining, this was found to consist of pus and many organisms resembling colon bacilli.

Following this, the patient was taken to the X-ray room. The first film was made with an opaque catheter in the right ureter; the second, after injection of 20 c.c. of 15 per cent sodium iodide. This was aspirated and the third film was made after injection of 50 c.c. of 10 per cent sodium iodide.

Two days later, under gas-oxygen anesthesia, a No. 18F cystoscope was introduced easily, except for some obstruction about the vesical neck, the nature of which was not determined. A large amount of slightly cloudy urine was withdrawn through the cystoscope. Pressure on various parts of the abdomen brought out an additional large amount of urine.

With about 50 c.c. of 2 per cent boric acid in the bladder, the interureteric ridge was recognized, and was found to be confluent with the ureteric ridge of either side. There was a good deal of coarse trabeculation just above the region of the trigon on either side, more marked on the right. The right ureteric ridge extended up as a cord and a rather large ureteral meatus was seen to open upon it. The left ureteric ridge was more or less smooth and the left ureteral orifice apparently dimpled. There was a great deal of hyperemia of the vesical mucosa, but not so much as would be expected with the patient's urine as cloudy as that which was obtained.

Inasmuch as the patient was moving about a great deal and rather difficult to hold in position for long study, a No. 6F catheter was introduced immediately into the left ureteral orifice. It met a slight obstruction at 3 cm., which it passed without a great deal of difficulty. It then passed a distance of about 15 cm., where another obstruction was met. The catheter passed an additional 5 cm., a total distance of 20 cm. into the ureter. This was thought to be a sufficient distance to reach the pelvis of the kidney, unless the catheter had coiled up in the ureter.

The cystoscope was then removed and the catheter was found to drain continuously in drops. Using a syringe, the kidney was aspirated and about 20 c.c. of urine was sent for examination. An additional 40 c.c. of urine was withdrawn, the total amount withdrawn being about 60 c.c. (Fig. 3). Urine continued to drip from the catheter.

The first film was made plain. Following this, 10 c.c. of 15 per cent sodium iodide were injected and another film made. This was to determine whether or not it would be safe to inject an additional amount.

Fifty c.c. were then injected into the ureter and kidney.

The roentgenograms speak for themselves. The child has a greatly dilated ureter on each side, the same being true of kidney pelves and calices. The kidneys are both considerably impaired, the one on the left being almost entirely destroyed. In addition to this, he has a very greatly dilated and trabeculated bladder. All of his urinary pathology, we are sure, is due to obstruction at the urethral vesical orifice.

Dr. Bailey's opinion is that the only method by which the patient can hope to get any measure of relief is from prolonged and complete bladder drainage, and that the only way this can be accomplished is by the use of a suprapubic tube. He thinks that a suprapubic tube will have to be worn for a long time, possibly a year, in the hope that the upper urinary system will improve its function sufficiently so that additional operating can be done upon the urethra, which will enable the patient to void. He does not see any other method of prolonging life.

This boy returned for examination two months later, at which time his excretion of phenolsuphonephthalein was 60 per cent of the total; his non-protein nitrogen was reduced from 200 mg. to 50 mg.; his urinary output was 60 oz. in 24 hours.

Examination of the genito-urinary tract, using uroselectan, demonstrated very little decrease in size in the ureters, renal pelves, and calices. Suprapubic drainage was maintained, and the patient was sent home, being directed to return in three months.

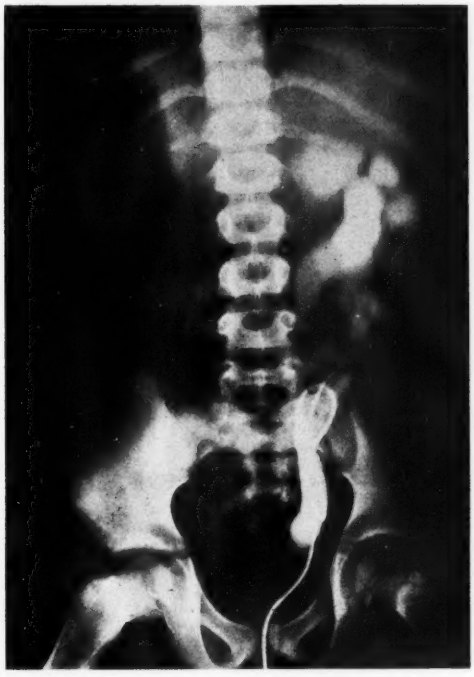

Fig. 3. Right pyelogram and ureterogram. Practically identical with the appearance of left kidney and ureter. Slightly better function. Capacity 90 cubic centimeters.

SUMMARY

The intravenous injection of uroselectan demonstrated tremendous dilatation of the entire urinary system above the urethral vesical orifice, this being confirmed by use of the cystoscope and pyelograms. The patient's renal function is markedly impaired and an enormous amount of pus is present in the urine, his blood chemistry showing a non-protein nitrogen of 200 milligrams. His general physical condition, in spite of these various abnormalities, appears very good.

On Nov. 24, 1930, a suprapubic cystotomy was performed. The operation was uneventful and a congenital valve at the urethral vesical orifice was clipped. Suprapubic drainage was instituted, and will be continued indefinitely, in order to prevent any back pressure on his urinary tract and to give an opportunity for the kidneys, ureters, and bladder to return to normal size. His prognosis is grave, as there is very little chance of these kidneys and ureters returning to normal function. The patient will, undoubtedly, succumb to some

intercurrent infection within the next few years.

This case is reported to emphasize the importance of early recognition of this type of urethral vesical obstruction. The patients are ordinarily seen late by the roentgenologist or the urologist, whereas these cases should be diagnosed early in infancy by the attending physician, as only early operation offers chance of recovery.

The disease must be recognized and treated before damage to the bladder, ureters, and kidneys is too extensive for recovery.

TWO CASES OF BRACHYDACTYLIA

By ARTHUR E. PERLEY, M.D., QUINCY, ILLINOIS

Case 1.[1] The mother accidentally discovered this condition when she was examining the child's hand following a slight bruise. Thinking it must be a dislocation of the ring finger at the metatarsal phalangeal joint, she took the child to the family physician. Examination of the patient, a girl of ten, showed no other defects. The child seemed normal in every respect. The mother stated that there was no history of any physical defects in the family except that she herself possessed short distal phalanges on the thumbs, producing a widened and flattened tip, with a wide and short nail. This was hereditary for several generations, as could be remembered on her father's side of the house. Her other children were normal.

An X-ray examination of the right hand showed a distinct shortening of the fourth metacarpal. A film was made of the left hand for comparison and was found to be normal. There were two other points of difference: an increased diameter of the entire bone, probably compensatory, and in the epiphyseal extremity the epiphysis was displaced slightly towards the dorsum, and the epiphyseal line was nearly closed.

Case 2. The second instance is in a young woman, about twenty years of age, who possesses a bilateral brachydactylia in the fifth metacarpals of both hands—a very typical case. The X-ray appearance reveals a fairly normal fifth metacarpal, which differs from the others by being shorter and having a single nodule in the shaft. In all other respects she is normal, and she is by occupation a stenographer. She states that her mother and her mother's mother's father had the same condition (see Fig. 1).

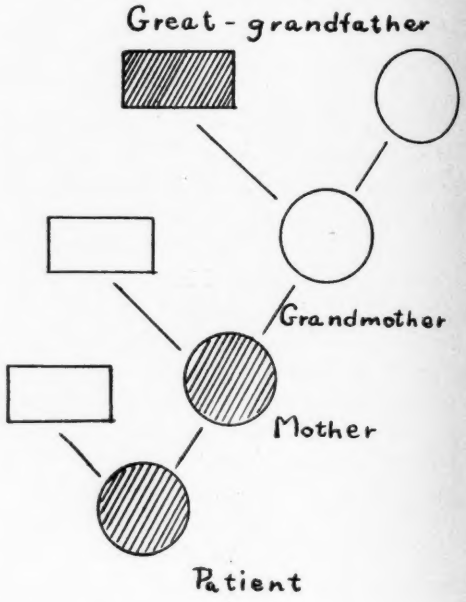

Fig. 1. Diagram of familial incidence of condition existing in Case 2.

Köhler (1) states that "in one form of brachydactylia the third metacarpal alone is shortened, occasionally also the fifth, the fourth only rarely." Cohn (2) says that

[1]Case 1 is reported by courtesy of H. G. Sinnock, M.D.

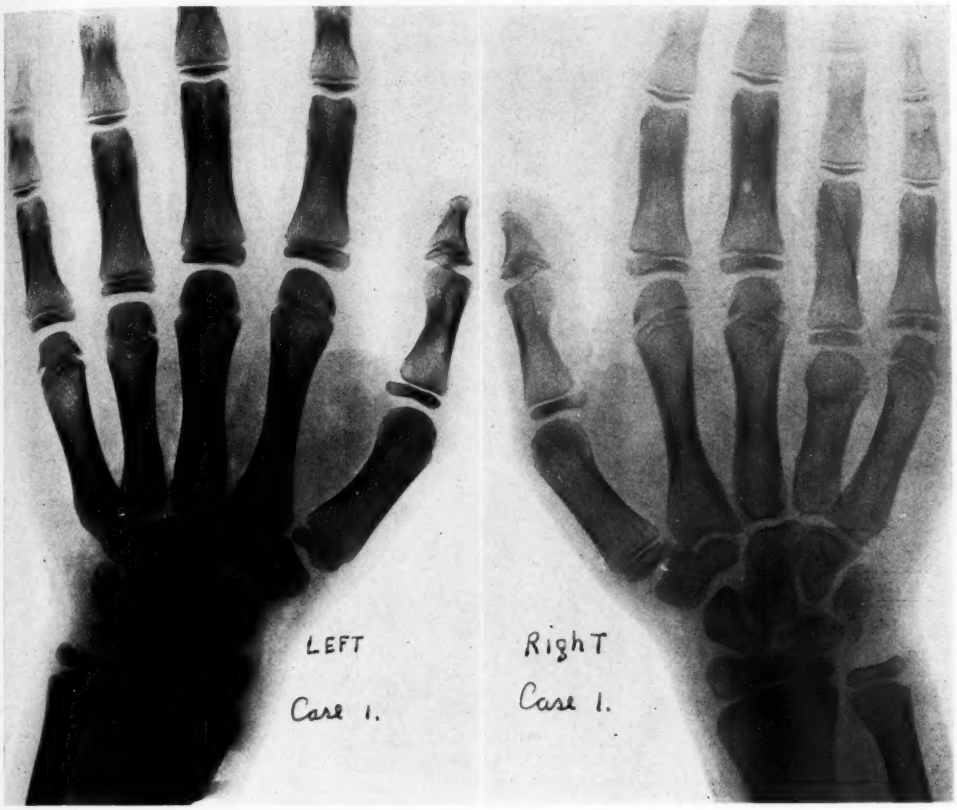

Fig. 2. Case 1. Roentgenograms of hands.

the epiphyses of the metacarpals start to ossify in their respective centers at three years and are closed at eighteen years. Boorstein (3) presents an interesting study of this question. He reports five cases of symmetrical congenital brachydactylia. In his conclusions he states:

"Cases of short fingers should be reported with the same accuracy as polydactylism so as to facilitate the studies of the embryologist.

"Bilateral congenital malformations can usually be traced to heredity, while a unilateral congenital malformations may be explained on principles of embryonic pressure defects.

"The origin of the metacarpals and metatarsals is similar though the center of ossification may not be so, as seen by the similar deformity in my cases.

"The fourth metacarpal was the most frequently involved in my series.

"The fourth metatarsal is also frequently involved."

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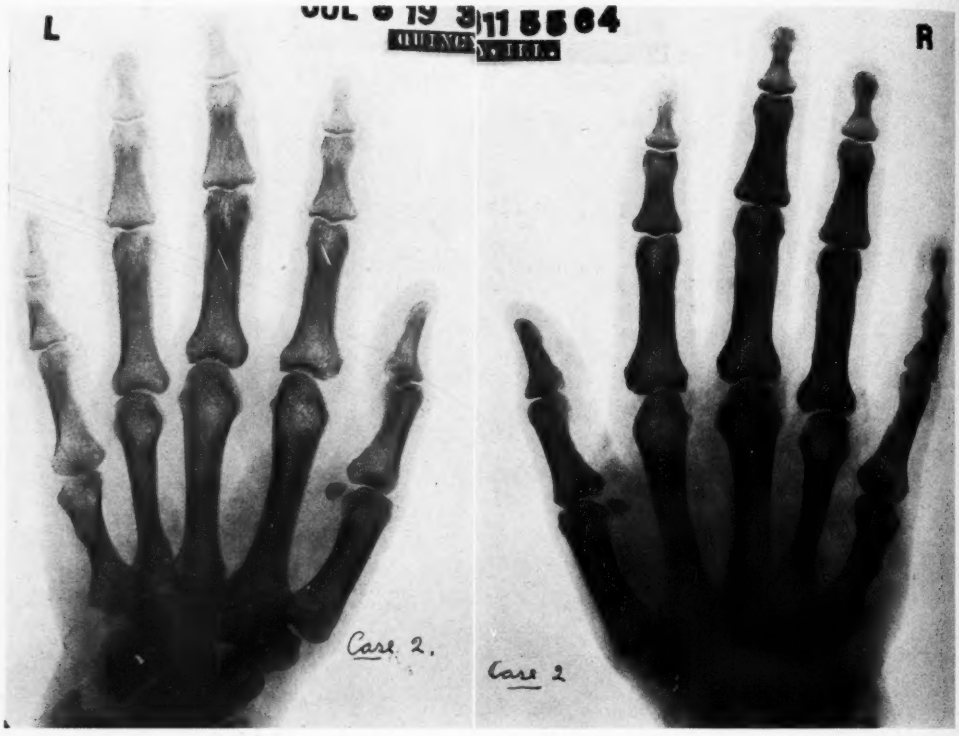

Fig. 3. Case 2. Roentgenograms of hands.

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RHYTHMIC PRECIPITATION IN GALLSTONE FORMATION

By HARRY B. WEISER, PH.D., and GEORGE R. GRAY, B.S.
Rice Institute, HOUSTON, TEXAS

Some ten years before the introduction of antiseptic surgery by Lister, the importance of an organic binder in concrement formation was shown by A. von Heyde, who dissolved out the crystalline material from urinary calculi and observed a residual framework. That gallstones may form under certain conditions without co-existing inflammation was demonstrated over twenty years ago by Aschoff and Bacmeister and by Schade.

Stones of the "pure cholesterol" type are formed in the absence of inflammation, while the so-called "layered" stones, or "common gallstones," are associated with inflammation. The presence in the bile of irreversibly precipitating hydrophilic colloids, such as serum albumin, globulin, and fibrin, profoundly affects the nature of the concrement. A typical stone of the colloid-cholesterol-calcium-pigment type consists of a central mass, made up largely of albumin, calcium, bilirubin, and cholesterol, and a surrounding mass characterized by the presence of concentric rings of calcium-bile pigment. Since the relative amounts of the various constituents which make up the

stone may vary widely, the physical properties in turn will show wide variation.

The appearance of the concentric rings suggests to the colloid chemist that they may originate as a result of rhythmic precipitation. In this laboratory it has been found possible to obtain rhythmic bands of calcium-bile pigment in a mass of cholesterol precipitated in the presence of a hydrophilic colloid. Cholesterol was thrown down in the presence of calcium salts, was freed from excess liquid, and was surrounded by a solution of bile pigments prepared from human gallstones. The bile pigment diffused into the mass and the calcium-bile pigment was precipitated in concentric rings. The arrangement of the rings varied with the shape of the mass. No rings were formed in the absence of hydrophilic colloid.

It would thus appear that the formation of the so-called "layered" gallstones is favored or initiated by inflammation, which yields irreversibly precipitating protein materials, such as albumin and fibrin. Pathologic changes bring about the precipitation of cholesterol, carrying calcium with it, the nature of the precipitate depending upon the amount of hydrophilic colloid present. Into this mass the colloidally dispersed bile pigments diffuse and are precipitated in the form of rhythmic bands. The structure and arrangement of the bands is influenced by the shape of the mass, its density due to pressure of other stones, and by variations in the composition of the bile fluid. After the bands are formed, the structure may be invaded by radial crystallization of the cholesterol, cracks may develop, further deposition of cholesterol may occur, or the stone may undergo alteration in other ways, producing the wide variety of forms known to the surgeon and pathologist.

SECTION ON RADIOLOGY, SOUTHERN MEDICAL ASSOCIATION

The Section on Radiology of the Southern Medical Association has prepared a good program for the coming meeting, Nov. 18 to 20, at New Orleans. There will be two forenoon sessions, both filled with papers by leading Southern radiologists. Eugene P. Pendergrass, M.D., of Philadelphia, will be the guest speaker. There are two features of unusual interest this year—one is the Section luncheon which is to be held at noon on the 19th, and the other is the special educational exhibit. At the luncheon, the program will consist of presentation of cases of unusual interest (limit of discussion to any one case ten minutes). The Committee in charge of the educational exhibit has made assignments as follows: Cholecystography, Sherwood Moore, M.D., Osseous system, J. W. Pierson, M.D.; Chest, A. L. Gray, M.D.; Gastro-intestinal tract, A. B. Moore, M.D.; Genito-urinary tract, C. A. Waters, M.D.; Skull, Lawrence Reynolds, M.D.; Neck, Percy D. Hay, M.D.; Radiotherapy, Charles L. Martin, M.D.

The officers of the Section on Radiology are: R. T. Wilson, M.D., *Chairman,* Scott and White Clinic, Temple, Texas; C. H. Heacock, M.D., *Vice-chairman,* 20 South Dunlap Street, Memphis, Tenn.; J. C. Dickinson, M.D., *Secretary,* 302 Citizens Bank Building, Tampa, Florida.

EDITORIAL

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CONFERENCE ON BONE DISEASES AND BONE TUMORS

Recently there was held at Johns Hopkins University, in Baltimore, a most interesting and instructive conference on bone diseases and bone tumors by two of America's most outstanding workers in this field of medicine, Dr. J. C. Bloodgood and Dr. C. F. Geschickter. They were ably assisted by Dr. M. M. Copeland, a former co-worker of theirs, and also by the staff of the Surgical Pathological Laboratory of Johns Hopkins Hospital.

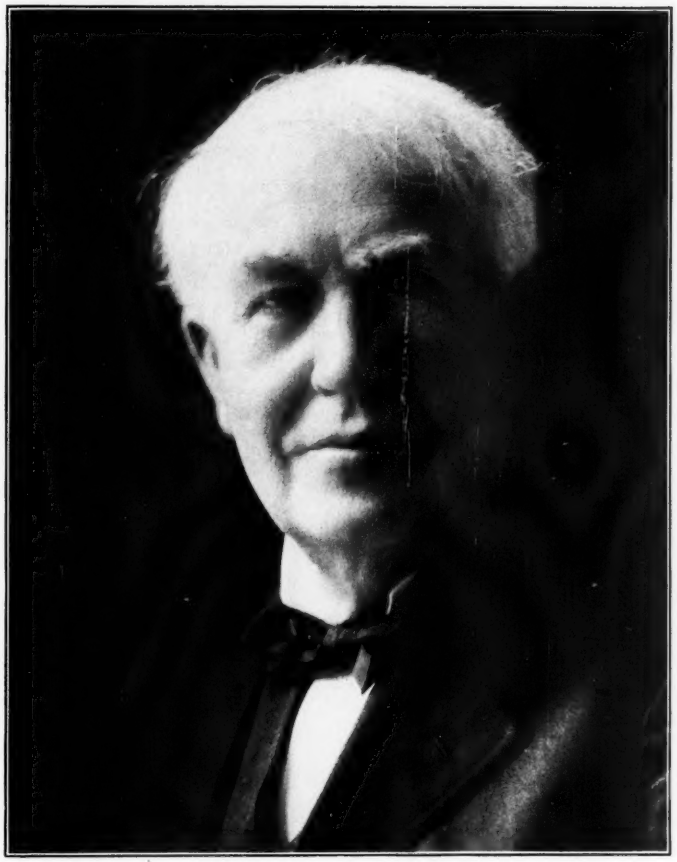
A large number of physicians were in attendance at this conference, representing many different specialties of medicine, including radiology, surgery, internal medicine, and pathology, from different sections of the United States.

The clinics were ideally arranged, permitting the spectators an unobstructed view of the whole proceedings. They were presented in three daily sessions—morning, afternoon, and evening—in such a manner as to excite the interest of everyone present, all of which contributed materially toward making the conference a tremendous success. At each session lantern slides were shown, to present illustrative cases of the various clinical entities. Four stereopticon lanterns were used to show simultaneously views of the X-rays, gross specimens, and microscopic sections. A brief clinical history of the case under consideration was read, but the diagnosis and treatment were withheld until every physician in attendance had had an opportunity to study carefully the X-ray films and lantern slides and to make a written diagnosis. The different diagnoses made were counted and assorted and the result announced publicly. The correct diagnosis of the case, which was made in the Surgical Pathological Laboratory of the Johns Hopkins Hospital, was then announced to the audience. In closing, Dr. Bloodgood and Dr. Geschickter gave a very interesting discussion of the case, explaining in a clear and forceful manner the high points of importance in the diagnosis and treatment.

There were perhaps a hundred such cases similarly presented, all of which elicited considerable discussion. In this manner actual differences of opinion and varying percentages of agreement on a given diagnosis and treatment were ascertained from the large audience of physicians.

Those present were made to appreciate the value of roentgenologic examination of bone tumors and bone diseases when interpreted by physicians trained in roentgenology, and also that it was possible in certain cases to make a correct diagnosis from the roentgenographic examination alone. They were especially impressed, however, with the importance of employing every possible means in making such a diagnosis, no single method being relied upon exclusively.

This wonderful bone clinic demonstrated the momentous importance of roentgenology and the exalted position it occupies in the broad field of medicine. The reliance placed on this comparatively new specialty by such great physicians as Dr. Bloodgood, Dr.



THOMAS ALVA EDISON

Thomas Edison is dead. A man of intellectual genius had to respond to the call of One greater than all the geniuses of all the world.

His life should serve as an inspiration to all young men who have to travel the difficult paths of life. He has demonstrated by his life's work that with courage, ambition, and intelligence it is possible to become an outstanding figure in the affairs concerning the wellbeing, comfort, and needs of the people of the world. It is but necessary to be reminded of Edison's own words, " 'Impossible' is an impossible word," to appreciate why he was the world's greatest man.

His example of service and self-sacrifice has been inspiring to all professions and none appreciates it more than the Radiological Society of North America.

Geschickter, and others who participated in this conference will serve to stimulate all roentgenologists of this and other countries to strive onward toward making roentgenology more and more useful as an efficacious agent in the diagnosis and treatment of disease.

Those who attended the conference were high in their praise of this splendid educational exhibit, and were especially appreciative of the untiring efforts of Dr. Bloodgood and Dr. Geschickter in having made it possible for everyone to benefit tremendously by this demonstration. It must be gratifying to them to know that each succeeding class is becoming more and more efficient in the diagnosis and treatment of bone diseases. The present class showed definite evidence of previous instruction by these eminent authorities, as the percentage of correct diagnoses given this year was far greater than that of any previous class. Surgeons were made better surgeons; roentgenologists were inspired, and will in the future make more accurate diagnoses, and pathologists will make better consultants.

In order that the physicians of this country may receive in part the benefits of this great conference, RADIOLOGY will publish all the cases demonstrated at this meeting. It is our plan to present the correct diagnoses on another page of the same issue in which the facts are set forth, so that our readers may study these case reports and make their own diagnoses before reading the correct diagnoses as made in the Surgical Pathological Laboratory of Johns Hopkins Hospital.

LEON J. MENVILLE, M.D.

THE ANNUAL MEETING OF THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

The seventeenth annual meeting of the Radiological Society will be held this year at the New Jefferson Hotel, St. Louis, Missouri, from November 30th to December 4th. This meeting should surpass in attendance and importance all others held since the beginning of the Society. This opinion is based in part on the geographical situation of the meeting place, and particularly on the interesting and educational program on which the President and the Program Committee have worked laboriously for months, having obtained important articles of great value for our members. We can be assured that the character of the papers and the authoritative utterances of the contributors will be of the highest order. Every member of the Society should attend this meeting, even at a sacrifice, as we are certain that each one will be amply rewarded by the highly scientific and educational program to be presented at that time.

We often hear medical men say, "What benefits do we derive from medical meetings? They bore us to death with their lengthy papers, which can be read at leisure at home in the Journal. Why then should we be made to undergo such expense for nothing? Besides, we are asked to leave a lucrative practice in the hands of competitors who never attend meetings." And so on they "rave into the night," reminding us of the two old women in a train who were kicking about the ventilation. One wanted a window open and the other wanted it shut.

"I'll die of suffocation," said one of them, "unless this window is opened."

"And I am sure I will die of draft if it is," said the other.

"Conductor," said one of the passengers, "suppose you open the window until one of

them dies of the draft, and then close it and kill off the other one."

Osler once said, "It is one of the greatest tragedies of life that every truth has to struggle to acceptance against honest but mind-blind students." This statement has great significance at this time, as there are many physicians who could obtain the whole truth about radiology by attending radiological meetings, but prefer to remain mind-blind by staying at home. Don't be mind-blind, but, if you are, come to the meeting where the blind shall be made to see, and the mind shall be made clear.

Why are some radiologists successful and others not? A successful radiologist is one who believes in medical progress and contributes to the advancement of radiology by appearing occasionally on the official program of his society and faithfully attends, whenever possible, all radiological meetings, participating actively in their deliberations. Such meetings offer to their members the opportunity not only of becoming acquainted with the most eminent radiologists of this and other countries, but also of obtaining their views and experiences regarding recent radiological progress. In this manner, first-hand information is available appertaining to the modern methods of applying radiant energy in the diagnosis and treatment of disease. By participating in the discussions we are given the privilege of presenting our personal ideas and experiences on the subject under consideration, and also the prerogative of interrogating the essayist on any subject which is not made clear. Such an exchange of thoughts and ideas is one of the many worthwhile advantages obtained at a meeting.

Then again, we must not overlook the contacts that are made there. Warm friendships spring up between men that often become life-long in duration, and after a while the annual meeting becomes a reunion with men for whom we have a high regard and to whom we have become closely attached. The social features in connection with such contact will help to remove troublesome burdens from our minds, thereby making us happy, so that on our return home we will resume our practice with a different mental attitude.

Perhaps the greatest benefit to be derived from a radiological meeting, and the most important reason why we should attend, is the opportunity of receiving gratuitously a remarkably effective Post-graduate Course in radiology, all compressed within a few days. A superficial perusal of the official program is sufficient to show the names of eminent specialists in the field of radiology, gathered from all parts of this country, presenting for our consideration and education the results of their experiences with and studies of subjects of great interest, in order that we, of the common fold, may be benefited and become better informed radiologists.

At each annual meeting the Radiological Society presents to its members an interesting scientific exhibit of great educational value, which in itself is worth any sacrifice made in attending the meeting, and those who become lecture-weary listening to papers can profitably spend their time in this exhibit and gain valuable information, as it represents research and experimental radiology.

Due to the present economic situation, many of us may feel that we are unable to sustain the expense incurred in attending this meeting. We must remember that this is *The Meeting* of the year for the radiologists, and the expense is not so great as we might at first believe. The price of food has gone down considerably, and hotel rooms can be had at reasonable rates. The railroad expense will be one and one-half fare, if enough members register, and we have every reason to believe that this will be the case at the coming meeting.

By the time this editorial reaches our readers, they will have received their official

prospectus which outlines the scientific program, scientific and commercial exhibits, and, what is always important, the social festivities which act as a circuit breaker in the high tension current of events which accompanies annual meeting duties. These social entertainments produce complete relaxation and might be considered as an ideal vacation period. Therefore, Doctors, pack your little grips, hop on the train, and attend the largest and best meeting the Society has ever had, and don't let us be like the physician who, because he was too lazy to say his prayers at night, purchased a piece of cardboard and wrote a few sentences of prayer upon it. When he hopped into bed, he pointed to the card and said, "Lord, them's my sentiments."

SUGGESTIONS TO OUR APPARATUS-MAKERS

One remembers having heard that "accidents will happen, even in the best regulated families," and if one substitutes "X-ray departments" for "families," the statement still holds good. Nevertheless, there are accidents and accidents—some are avoidable, some unavoidable. With proper construction of apparatus, care in its use, and adequate inspection at regular and reasonable intervals there is no reason why accidents in X-ray departments should not be as rare as the perfect roentgenologist.

One reads from time to time of patients or attendants being injured or even killed through coming into contact with high tension leads while the tube is activated; perhaps one has even had personal experience of the sensations produced by contact with a high tension line. One victim has stated that he is prepared to testify that a momentary contact with a live lead puts more vitality into the system than does three months' use of an electric belt. He speaks feelingly, having tried both.

One also hears of acute X-ray burns, usually the result of "accidental" omission of a filter during therapy. These shocks and burns may be termed the major X-ray accidents, and, in modern apparatus, provision is being made to prevent their occurrence. Thus we have "shock-proof" apparatus and therapy sets which will not function unless there is a filter in position.

Perhaps it may be of some interest to others if I record three recent personal experiences of what one may term minor X-ray accidents, as distinct from the better known, or major, ones which have been mentioned above.

Much has been written recently about the dangers of fire in X-ray laboratories as a result of the combustion of films, either accidental or spontaneous, and various methods of storage, ventilation and so forth have been suggested as necessary to insure freedom from the danger of fire. The following accident recalls a possible source of fire and emphasizes the need for a separate storage place for films.

A superficial treatment set, fitted with a mercury break, apparently developed a leak in the tubing which brought the gas to the interrupter. The transformer, interrupter, etc., were enclosed in a cabinet in the usual manner, with the result that sufficient gas leaked into the cabinet to form an explosive mixture without giving any indication of its presence. When the machine was given a short trial run, preparatory to commencing treatments for the day, an explosion occurred. This was of sufficient force to burst open the doors of the cabinet, from which flames were seen to issue. The gas and electricity were immediately shut off and the flames were extinguished. Examination of the set revealed that the insulation had been burned off several wires, that a porcelain cleat had been cracked by the heat, and that part of the inside of the cabinet had been scorched. The leaking gas tube appeared to

be the only satisfactory explanation of this accident. It was not a case of an explosion inside the interrupter, as the gas had been turned on and allowed to burn until the flame was yellow, and the safety valve was not disturbed. I am informed that this is not an unusual accident but surely it ought to be an avoidable one. It appears probable that if the cabinet were properly ventilated, instead of being practically an airtight space, and if the tubes which carry the gas to and from the interrupter were made of sufficiently strong rubber, inspected at intervals and replaced when necessary, such an accident could not take place. The tubing which was in use when the explosion occurred was ordinary surgical tubing fitted when the set was supplied two months previously. A much stronger tubing has now been fitted and arrangements have been made for its frequent inspection. In this way we hope to avoid a repetition of this particular source of danger.

Another accident, also in connection with a set for superficial therapy, appeared to be rather more uncommon. The positive lead to the hot cathode tube was an ordinary rubber-coated one, rather the worse for wear and of the type which shows multiple corona discharges if used during screening. This lead eventually broke, except for a few strands of wire, and the broken pieces coming near each other caused sufficient arcing to melt the rubber insulation during the course of a fairly long treatment. A drop of molten rubber fell on the bare wrist of the patient and caused a slight burn. Fortunately the patient did not jump or try to get off the couch. She merely told the attendant to stop the current and when she explained that something hot had dropped on her wrist the source of the burn was easily discovered. Here again the accident was an avoidable one. More substantial leads have been fitted and they are examined at intervals with the tube working in a darkened room, thus enabling slight breaks to be detected at an early stage of their existence.

The third accident, this time in connection with a diagnostic unit, was similar to several which have been reported by Carty,[1] Jones[2] and others. The supporting cable of a very heavy vertical tubestand broke as the tube was being raised preparatory to placing a patient on the Potter-Bucky diaphragm. The tube carrier fell with such force that a fairly large dent was made in the aluminum top of the Bucky, despite the efforts of the technician to break the fall. The cable had been inspected frequently but the break occurred just inside the supporting pillar, in a rather inaccessible situation. This particular stand has a locking screw which can be used to fix the tube carrier in position, but this device is of no help if the break takes place while the carrier is being moved. The locking screw does not fasten on the supporting pillar, as so many do, but on a separate flat metal bar. In order to prevent a similar accident from injuring a patient this metal bar was removed and replaced by a thicker one, notched at half-inch intervals. A spring ratchet was fitted to the tube carrier so that it was necessary to move a handle up and to maintain it in this position while any downward movement of the carrier was being made. Immediately the handle was released it was impossible for the carrier to descend, unless it sheared off the notches on the steel bar. This was not likely to take place through breaking of the cable. The device did not interfere with the upward movement of the carrier. It, or some similar device, ought to be fitted to all upright tube stands, but it is not suitable for use on a screening stand. It affords almost complete protection from dangers to the patient through the breaking of a cable and is certainly more effective than Carty's suggestion that the tube carrier should be grasped firmly with one

[1]Carty, John R.: Radiology, June, 1929, XII, 495-498.
[2]Jones, W. E.: British Jour. Radiol., 1927, XXXII, 303.

hand while it is being moved over a patient. In the case described this measure would not have prevented the patient from sustaining an injury, as the carrier weighs about 250 pounds. It is perhaps necessary to explain that this very heavy stand is in use in order to minimize the effects of the vibration produced by the traffic passing within a few yards of the room.

It would be interesting to hear from others of unusual accidents which have been met with, and no doubt the recording of these and other accidents may prove helpful to the harassed maker in his efforts to produce apparatus which will be practically fool-proof, self-adjusting, safe, and satisfactory. What is really required is an apparatus which will meet the patient at the door, make the exposure, collect the fee without a blush, and hand over the finished print and report, all within a few minutes. Who is going to put such a machine on the market? There ought to be a fortune for the pioneer.

HUGH MORRIS, M.D.
Manchester, England

STAFF MEETING

At the coming St. Louis meeting of the Radiological Society of North America, the Editor of RADIOLOGY will hold a conference with the Editorial Staff of the Journal. Suggestions will be offered and a general discussion will be had concerning the future growth and expansion of RADIOLOGY. The need for such a conference is of paramount importance, due to the increasing radiological literature of this and other countries that should be published in RADIOLOGY in order that our readers may have the opportunity of keeping abreast of the modern progress throughout the world. In this manner, the American radiologists should become so well informed in the science of radiology that they will assume the position of leaders in this field of medicine.

RADIOLOGY is owned and controlled by the Radiological Society and is edited principally for its members; for this reason, we consider it of prime importance to continue publishing articles bearing on the diagnostic and therapeutic aspects of radiology. However, we must realize that the science has expanded to such an extent that radiology is now closely associated with other sciences, and its progress in this regard is considered of importance to all radiologists. The Journal will make every effort to keep its readers acquainted with the newer developments in these allied sciences as they occur.

The present Journal contains reading matter of interest not only to the radiologists but to the entire medical profession. It is being used in medical educational institutions for teaching purposes and reference work. The Journal can serve a most useful purpose in educating certain members of the medical profession as to the importance of radiology. This could best be accomplished by sending copies of the Journal to such physicians, who will then have a clearer understanding and appreciation of its scientific value, so that they can easily distinguish between a radiologist, a physician, an osteopath, and a chiropractor who uses the X-ray in the practice of medicine, without radiological qualification. Plans are under way which we believe will make this possible.

To do this, we shall need the co-operation of the Editorial Staff and the entire membership, and also financial help. We have reasonable assurance that the Chemical Foundation will continue its generous support toward such an expansion—it would be impossible without their altruistic support. The Radiological Society should, in turn, show its appreciation of their philanthropy by a continued co-operation and by lending every effort toward an increased circulation of the Journal.

What is needed at the present time is a radiological journal directed by a combination

of all radiological societies into one large organization to serve as the mouth-piece for all the radiologists of America. In this manner, radiology would have an authoritative voice and the power to command the same attention and respect as the other highly specialized branches of medicine, being on a parity with them all.

THE PRESIDENT'S INVITATION TO THE ANNUAL MEETING

The Annual Meeting of the Radiological Society of North America is now but a short while in the future. During the week following the 30th of November the event which marks the culmination of the Society's year will take place at the New Hotel Jefferson, St. Louis. There will gather physicians from the great medical centers and from small towns, celebrated specialists and men who yet have to achieve fame—the object being an exchange of ideas, open discussion of problems, report of work done, an opportunity to view and talk over the latest advances in apparatus, and the pleasures of renewed comradeship. The men who advance are the men who are known, and medical meetings are the open forums where such contacts are made.

That we all may give and gain, let us come to the St. Louis meeting in a spirit of friendly co-operation.

BUNDY ALLEN, M.D.
President.

COMMUNICATIONS

PHOTOMICROGRAPHS

The Editor wishes to enlist the co-operation of authors in rendering reproductions of photomicrographs of greater value to the readers. If, in preparing the print of a section of tissue, the author will point out (by drawing lines and writing in the margin) the different types of cells to which attention is directed, the influence of the microscopic study upon the diagnosis will be made evident. This, in the final analysis, is the real reason for publishing the illustration in connection with the paper.

SHREVEPORT CLINICS

The physicians of Shreveport, Louisiana, held a three-day clinic, October 21-23, at the Charity Hospital, Shreveport. The announcement set forth the plan as follows: "You are requested to send to the hospital one or more patients that you wish to present for discussion. Between the hours of 12 and 1 daily these patients will be brought into the various clinic rooms. You will present your own patient, together with the laboratory findings that have been made in the hospital. The discussion of the case will then be taken up by the local physicians who are appointed to preside in each department as shown by the program. General discussion and questions will follow.

"The private sanatoriums . . . have offered their facilities free of charge for this purpose, and patients from any part of the Tri-State area may be sent. You are asked to send your patients on or before Monday, October 19, to the Charity Hospital or to any one of the private sanatoriums, with a letter indicating that you wish to have the case studied and the necessary laboratory work done so you can present it during the Clinic. No charge of any kind will be made to the patient or to you for the room, bed, laboratory, or X-ray service.

"The Clinic Committee urges you to accept this invitation and send your patients ahead of time to any of our hospitals for laboratory and X-ray examination so that you may take part in our program. Facilities will be available to care for from 75 to 100 patients of this kind, and, since all specialties are open for their presentation daily, at least this number can be scheduled. No registration fee . . . . . Every one must

register before attending the clinics. Free lunch daily in the hospital dining room to all registrants. General plan of Clinic—3-day session. No papers."

The clinic was arranged in departments of Eye, Ear, Nose, and Throat; Obstetrics, Genito-urinary Cases, Internal Medicine and Allied Branches, and X-ray.

It seems an excellent idea, and we wonder if similar clinics have been conducted with success elsewhere.

A NOTE FROM THE EDITOR

In order that confusion may not arise concerning the editorial on "Standardization of Hospital X-ray Equipment" in the August issue of RADIOLOGY, the Editor wishes to say that the illustrations merely served to demonstrate the number of pieces of equipment essential, and not at all the type or make of any particular manufacture.

IN MEMORIAM

HENRY A. CHAPIN, M.D.

It becomes our sad duty to report the death of Henry A. Chapin, M.D., of Jacksonville, Illinois, who passed away on August 10, 1931, after a short illness.

Dr. Chapin was one of the original group of men who met in 1915 and organized the Western Roentgen Society, the forerunner and direct progenitor of the Radiological Society of North America.

He was born in White Hall, Greene County, Illinois, July 25, 1872, and was educated in the grammar and high schools of his birthplace, the Northern Illinois Normal School, the College of Physicians and Surgeons, of Chicago, and was graduated in medicine, receiving his M.D. degree from the Baltimore Medical College in 1895. Soon after, he located in White Hall, Illinois, and began the practice of medicine. He moved to Jacksonville, Illinois, in 1917, and here specialized in radiology, very soon confining his practice almost entirely to it.

At the time of his death, Dr. Chapin was radiologist to the Jackson State Hospital, the Passavant Memorial Hospital, the Illinois School for the Blind, the Illinois School for the Deaf, and the Chicago and Alton Railway, as well as radiotherapist to Our Savior's Hospital. He was a member (and past president) of the Morgan County (Ill.) Medical Society, past president of the Jacksonville Medical Club, vice president of the Rotary Club, a member of the Illinois State Medical Society, the American Medical Association, the Chicago Roentgen Society, and the Radiological Society of North America (charter member). He was also a member of the Masonic order and a Trustee for many years in the State Street Presbyterian Church of Jacksonville.

During the World War he served on the Medical Advisory Board in District No. 16, rendering faithful and efficient service in that capacity.

Members of the Radiological Society are grieved at the passing of their associate and offer sympathy to the family Dr. Chapin has left behind him.

I. S. TROSTLER, M.D.

BOOK REVIEWS

MEDICAL JURISPRUDENCE. By CARL SCHEFFEL, PH.B., M.D., LL.B., P. Blakiston's Son & Co., Philadelphia, 1931. Pages, 313, green buckram. Price, $2.50.

This most interesting, valuable, and instructive book by a lawyer-physician of parts has recently come to my desk. It is different from all others of its kind in that, instead of trying to teach the reader and acquaint him with how medical matters affect the solution of legal problems, it seeks to show—and succeeds quite well—how

legal matters affect the physician in medical affairs.

The contents—after a clear, sensible introduction to the general subject—consists of chapters on "The Contractual Relationship of Physicians," "How the Law of Agency Involves Physicians," "Physicians and Torts," "Witnesses and Evidence," "Property Interests of Physicians," "Physicians and Criminal Responsibility," and "Physicians as Lawmakers," all of which are well indexed.

Each of these chapters is appropriately divided into various sub-heads and the subjects are intelligently discussed in a concise manner, citing decisions of courts of last resort in many instances and going into sufficient detail to lucidly set forth reasoning and teaching from cause to effect.

The lawyer-physician-author has written his book in a pleasant, readable style, not too strictly didactic and not too abstrusely dogmatic or pedantic. It is a valuable addition to our literature and should be on the book shelves, or, better, on the reading desk of every practising physician.

I. S. TROSTLER, M.D.

HANDBUCH DER GESAMTEN STRAHLENHEILKUNDE, BIOLOGIE, PATHOLOGIE, UND THERAPIE. Volume II, Strahlenklinik und Spezielle therapeutische Methodik. By Numerous Collaborators. Edited by PROF. DR. PAUL LAZARUS, Berlin, in two volumes (Volume II, of five sections, completed in 1931), 1,292 pages, 475 illustrations (some in color), paper binding. Published by J. F. Bergmann, Munich, 1927-1931 (1 section per year).

VOLUME II, SECTION 1, 264 pages, 137 illustrations, and numerous tables. Paper binding. Published in 1927. Price, 28.50 marks.

FRIEDRICH KRAUS has written the introduction for this volume as he did for the original work in 1912. In it he points out the value of radiotherapy in various diseases, traces its development, and briefly hints what its future course will be. He feels that radiant energy is the strongest weapon in the fight against malignant tumors.

HOLTHUSEN follows with a paper on biologic dosage and the radiosensitivity of various normal tissues and then takes up the reactivity of the various disease groups (page 14). The reaction of tissues is influenced by the following factors: temperature, metabolism, colloidal state, blood supply, acute or chronic inflammation, constitution, and state of the surrounding tissues. The effect of any dose varies with its time of administration, and with its quality. The quality and quantity of radiation and the duration of exposure must be individualized to fit each patient.

SCHWARZ (pages 46-59) considers the question of stimulation in roentgen treatment and thinks that even though a direct stimulation cannot be demonstrated one must admit the possibility of such an effect taking place indirectly in certain cases. He has an open mind on the Arndt-Schulz law but admits that most of the evidence opposes its acceptance.

ROLLIER writes on and illustrates the methods and technic of heliotherapy (pages 59-71) as carried out in his institute at Leysin. This form of treatment is valuable not only in tuberculosis but in sluggish wounds, ulcers, burns, gynecologic inflammations, and some of the infectious dermatoses.

REYN, of the Finsen Institute, describes and illustrates (pages 71-113) apparatus and technic of artificial light treatment and details some of the results which can be obtained by it.

WINTZ in an extensive article on the methods of roentgen treatment (pages 113-193) discusses the physical and biologic aspects of roentgen therapy in which he still

adheres to his conception of the "carcinomdosis," etc. He emphasizes the necessity of accurate diagnosis, pointing out the dangers of biopsy and insisting on extremely careful administration of treatment so that the best possible effect may be obtained. He illustrates by photographs the actual set-up for irradiation of various lesions and discusses their various technical aspects. A section on his method of copperization follows. He treats Grenz-ray therapy with utmost conservatism. The chapter concludes with a consideration of the occurrence, avoidance, and treatment of late tissue damages by roentgen rays. An extensive bibliography of eight pages is included.

HOLFELDER in his chapter (pages 193-213) writes upon his well known method of "field-selection."

WERNER (pages 213-246) takes up combination therapy, describing methods of sensitization and desensitization by means of medical or surgical procedures, injections, use of gland extracts, vitamins, etc.

GROEDEL (pages 246-264) closes the section with a consideration of the medico-legal aspects of roentgen damages.

VOLUME II, SECTION 2, 190 pages, 84 illustrations, and numerous tables. Paper binding. Published in 1928. Price, 21 marks.

The first part of this section is on radiotherapy in dermatology, the second on radiotherapy in gynecology. The opening chapter by J. BELOT (pages 265-334) takes up moderate voltage, which he most prefers for skin work. The treatment of various skin conditions is then considered in detail. This chapter enables the reader to rapidly form an opinion about the use of radiation in dermatology, a field in which the author is outstanding. This chapter is well supplemented by that of DÉGRAIS (pages 334-348) on the treatment of angiomas, in which, since most patients are children, he prefers radium to roentgen rays, and by that of PINCH (pages 348-366) on the radium treatment of malignant conditions of the skin.

L. SEITZ follows with a review of radiotherapy for gynecologic lesions (pages 367-424) in which he considers indications, methods, and results. Of special interest are the cuts showing the actual set-ups in X-ray treatment. He considers in detail complete and temporary sterilization and discusses associated dangers and damages. He gives a wealth of statistical results of radiotherapy in the gynecologic field and concludes that roentgen rays and radium together furnish the best method of treatment in inoperable carcinoma of the cervix. For the rest, he prefers radical operation and post-operative radiation.

VON SEUFFERT writes in detail (pages 424-445) about the treatment of gynecologic malignant disease with radio-active substances. He comes to the conclusion that the treatment of uterine and cervical carcinoma should be done with radium rather than with roentgen rays or by operation. For vulvar, tubal, and ovarian disease he prefers a combination of roentgen rays and radium. He states that the mortality of operation is ten times greater in favorable cases and fifty times greater in unfavorable ones than that of radium treatment and in this statement (pages 441-442) he considers 2,200 cases. A tabular view of statistical results closes this chapter.

LAHM closes this section with an interesting study of biopsies made before and after treatment in a group of uterine cancers, and points out the importance of the so-called "carcinomatogenen Stiftzellen" (basal cells) which he describes as present in 75 per cent of cases that did well and absent in 75 per cent of those that did not do well. In twenty-four cases that had an abundance of *Stiftzellen,* 16 (or 66⅔ per cent) were healed. Such cells, therefore, have a great prognostic significance.

VOLUME II, SECTION 3, 307 pages, 112 illustrations, and numerous tables. Paper binding. Published in 1929. Price, 36.80 marks.

This section opens with a very well done contribution by GÖSTA FORSSELL on the permanency of the radiologic healing of malignant tumors (pages 457-512), in which he has used as a basis of his report the experience at the Radiumhemmet in Stockholm. The subject is discussed both from a clinical and a statistical point of view. As is well known, the excellence of the follow-up system used at the Radiumhemmet gives to statistical evaluation of their results an incontrovertible accuracy, reliability, and completeness.

OPITZ's section on operation and radiation for malignant tumors (pages 512-527) emphasizes the advantages of radiation carried out rather from a biologic than an anatomical or local standpoint.

QUICK discusses the roentgen-ray and radium treatment of cancer of the pharynx and larynx (pages 527-539) as done at the Memorial Hospital, New York, with implanted radon, and of the metastatic nodes by his "conservative method."

JÜNGLING follows with a discussion of the radiotherapy of malignant tumors exclusive of those of the larynx, pharynx, breast, and the genito-urinary tract (pages 539-574), drawn from his own experience and from the literature.

WINTZ, in his article on radiotherapy for cancer of the breast (pages 575-613), takes up actual treatment methods, which he evaluates critically, and closes with an excellent and succinct statistical review of results in this field.

In the section on radio-surgery (pages 613-635) BAYET, SLUYZ, NEUMAN, CORYN, LEDOUX, DELPORTE, CAHEN, and GANDY describe the surgical applications of radium as carried out at the Radium Institute in Brussels.

MUIR's article on "buried technic" (pages 635-647) by removable platinum seeds containing radon considers that aspect of interstitial radiation.

BERVEN closes this section by a supplement and enlargement (pages 647-764) of the article by Forssell on the use of radiation in diseases of the mouth, teeth, nose, and eyes, in which the technical aspect of treatment and results are discussed in detail, and comparisons are made with results of other clinics. These two articles together give one a very complete idea of what may be accomplished by the "combined method" in the respective groups of malignant tumors.

VOLUME II, SECTION 4, 177 pages, 24 illustrations, and numerous tables. Paper binding. Published in 1930. Price, 22.50 marks.

LAZARUS writes the introductory chapter (pages 765-807) on radiotherapy as a means of combating cancer. He points out the increase of malignant disease throughout the world and says that it is due both to a senotrophic tendency of civilized man and to better recognition of the disease itself. The early diagnosis being one of the most important factors in the control of cancer, the author advises a yearly check-up of all persons beyond the age of forty. Treatment should be in charge of "blastologists" (physicians with special training in diagnosis and treatment of tumors). The intimate co-operation of surgeon and radiologist leads to improved results. By abundant statistics he shows the importance of early treatment and emphasizes the value of well-carried-out post-operative treatment, a field that should be better organized.

PARRISIUS follows (pages 808-846) with a very practical article on radiotherapy in internal medicine, in which he discusses some of the newer indications and technic of radiotherapy for arthritis, asthma, gastric ulcer, nephritis, erysipelas, cardiac dis-

eases, then the treatment of the endocrine disorders, and finally diseases of the blood-forming system.

SOLOMON (pages 847-857) writes on the roentgen treatment of Basedow's disease, which he thinks is very much to be recommended.

BACMEISTER considers the radiotherapy of internal tuberculosis (pages 857-877) not as a method of treatment by itself but as an adjunct to the general scheme of treatment.

MILANI and MELDOLESI discuss infectious diseases (pages 878-884) and point out the splendid results of well-given treatment in selected cases. They regard this field as still in its infancy.

BÉCLÈRE and LEVY take up the radiotherapy of diseases of the nervous system (pages 884-917), its indications, technic, precautions, and results, and give a comprehensive review of the literature in this field.

CZERNY and KARGER close this section with a thorough consideration of radiotherapy in the field of pediatrics.

VOLUME II, SECTION 5, 337 pages, 118 illustrations, and numerous tables. Paper binding. Published in 1931. Price, 45 marks.

HOLFELDER opens this section with an article on deep therapy for inflammations and hyperplasias (pages 943-995). In treatment of this group of lesions he favors complete abandonment of "moderate voltage" technics *(mitlere Tiefentherapie)* because of the likelihood of producing damage to the skin and subcutaneous tissues by such soft radiation. Such a point of view is in marked dissonance with the many reports in the literature of the successful treatment of many acute inflammations (because of their great radiosensitivity) with a single light dose of X-ray, and of other lesions in this group which have been successfully handled by repeated doses the total of which was well below the limit of tolerance of the skin. His point that radiotherapy should be exclusively in the hands of specialists is very well taken.

BERVEN follows (pages 996-1053) with a chapter on electro-endothermy. He bases this report on 2,672 diathermic operations at the Radiumhemmet and shows by case reports and photographs of typical cases the place this modality has in the treatment of tumors.

LAZARUS closes this volume by an article (pages 1054-1262) on the therapeutic applications of the radio-active elements, which is, in itself, practically a text-book on the subject. This section also contains a complete index to the second volume of the *Handbuch.*

UROLOGICAL ROENTGENOLOGY. A ROENTGEN ATLAS FOR THE GENITO-URINARY TRACT, WITH CASE HISTORIES AND AN OUTLINE OF UROLOGY IN ITS RELATIONS TO ROENTGENOLOGY. By HUGH H. YOUNG, M.D., Clinical Professor of Urology, Johns Hopkins University; Director, James Buchanan Brady Urological Institute, Johns Hopkins Hospital, and CHARLES A. WATERS, M.D., Associate in Clinical Roentgenology, Johns Hopkins University; Assistant Visiting Roentgenologist, Johns Hopkins Hospital. Second Edition, Revised. Published by Paul B. Hoeber, Inc., New York City, 1931. A volume of 564 pages and 559 illustrations. Price, $20.00.

The second edition of this book, like the first, includes a wealth of roentgenologic material so presented and classified as to be easily available for ready reference. There have been added several new chapters and the older ones have been amplified by additional cases and illustrations.

Of the new chapters the most important is that devoted to intravenous urography. In this, the authors give a brief review of the history of the method and an evaluation

of its clinical application, together with a brief presentation of the chemistry of Iopax and 30 roentgenograms made with this drug. Skiodan is briefly referred to but no roentgenograms are shown for which it has been employed, and it is certainly to be regretted that in a publication of this kind a more thorough comparison of the merits of the two drugs is not given.

The following chapter is devoted to arteriography of the aorta, emphasis being placed on the relative appearance of the arterial supply of the two kidneys. Eight illustrations are reproduced from 150 cases in which dos Santos, of Madrid, had injected sodium iodide into the aorta. The reader is left with the impression that the method is more spectacular than valuable.

The last chapter, entitled "Recent Progress in Technic," together with the second on "Topography, Anatomy, and Physiology of the Urinary Tract," have little bearing on roentgenology and could have been omitted without detracting from the work, as most of the material included is available in standard text-books.

In fact, the chief criticism of the book is the inclusion of too great an amount of unrelated urologic text, that tends to dim the presentation of the roentgenographic material, which is excellent in selection and reproduction.

THE ANNUAL MEETING

A special feature of the December meeting of the Radiological Society will be the showing of three films not on radiological subjects. One will give a demonstration of the methods used in experimental research laboratories. Another will be a film for educational purposes intended to teach the practitioner the diagnosis, both gross and microscopic, of the more important skin tumors and the inflammatory conditions which may be mistaken for such tumors, together with a survey of the microscopic appearance of such growths. The third will be a film on the diagnosis of bone tumors clinically, microscopically, and radiologically. The film on experimental research will be from the Crocker Laboratory; the other two will come from the Cancer Research Laboratory of the Surgical Pathological Laboratory of Johns Hopkins Hospital.

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Willis S. Peck, M.D.
Ernst A. Pohle, M.D., Ph.D.
D. N. Silverman, M.D.
J. Gower Stephens, M.D.
C. G. Sutherland, M.B.(Tor.)
Lester J. Williams, M.D.

ADDISON'S DISEASE

Value of Radiologic Examination of the Suprarenals in Addison's Disease. Guido Pescatori. Archivio di Radiologia, March-April, 1930, VI, 364.

The author refers to the possible existence of calcification of the suprarenals, which can be seen on X-ray examination, and after reviewing the differential diagnosis of calcification of the suprarenals and of other neighboring structures, he reports a case of this lesion in Addison's disease.

E. T. Leddy, M.D.

APPARATUS

A Modified Form of Radon Capillary Apparatus. H. H. Poole. Sci. Proc. Roy. Dublin Soc., 1930, XX, 1-6.

The author describes a modification of the Joly-Stevenson apparatus, requiring less manipulation and that of a simple nature, in order to safeguard the operator. The yield of radon is about 90 per cent.

Chemical Abstracts.

Intensifying Screens: Their Qualities and Evaluation. Josef H. Hartmann. Fortschr. a. d. Geb. d. Röntgenstr., June, 1931, XLIII, 758-776.

The mechanism of intensifying screens is to be explained as follows: Part of the roentgen radiation which, in the absence of such screens, would penetrate the photographic emulsion of the film without any effect is absorbed in the layers of a fluorescent medium and transformed into visible light, which, in turn, influences the photographic emulsion and thus produces an improved effect upon the latter. This effect of a fluorescent medium upon silver bromide is so efficient that when intensifying screens are used, the influence of the direct roentgen irradiation of a film is relatively negligible. Roentgen's original publications on X-rays contained remarks concerning the influence of these rays upon certain luminescent materials known as phosphores. Schleede, in 1897, apparently was the first to attempt intensification of photographic images by the use of fluorites. Very soon calcium tungstate was found to be one of the most efficient fluorescent substances for intensification purposes.

Quality and effect of intensifying screens are not judged easily as they offer very complex problems which are widely influenced by a large number of different factors which have to be considered. The intensifying factor, according to Glocker, may be defined as "the relation of the exposure time necessary to produce equal blackening with and without intensifying screens." This intensifying factor varies widely for the same screen, with the use of different photographic material. It is further influenced considerably by development of the films, their exposure, the degree of blackening measured, etc., and especially also by the quality of the primary roentgen radiation applied. Generally speaking, it is to be admitted that for the purposes of the roentgenologist, the double coated film, as well as the use of intensifying screens, leads to an improvement of contrast of the image obtained.

Different types of screens vary in their definition or the sharpness of the picture produced with their use. The definition obtained by intensifying screens depends upon five factors: (1) The size of the particles used as intensifying media; (2) the thickness upon the screen; (3) reflection of fluorescent light from the supporting structure of the intensifying layers; (4) the presence or absence of media within the fluorescent layers of the screen able to absorb scattered light within the thickness of the screen itself; (5) the possibility of the intensifying layers themselves to scatter the X-ray. It should be noted that there is always an inverse relationship between the intensifying effect of screens and the sharp definition desired by them, so that all factors which tend to improve the intensifying effect will impair definition and *vice versa.*

All intensifying screens have a certain lag, that is, the luminescence or phosphorescence continues for a certain length of time following completion of the exposure. Special investigation showed that with good screens no

lag could be observed for more than three minutes following the exposure. This well known observation on lagging of intensifying screens will be of importance for direct roentgen cinematography or equipment designed to produce serial films during short intervals with the same screens.

A reference to all technical detail contained within this interesting technical paper is not possible in the limited space. It should be borne in mind, however, that manufacturers' claims for intensifying screens for roentgenologic purposes by certain technical definitions are often misleading and impossible, as a considerable number of factors will have to be considered when a comparison of different makes of screens is desired.

HANS A. JARRE, M.D.

A New Apparatus for Superficial Therapy, with a Combined Valve and X-ray Tube. H. Graf. Strahlentherapie, June 13, 1931, XLI, 124-131.

This is a description of a new apparatus for superficial therapy, the valve and X-ray tube of which are combined in one vacuum tube. The apparatus can be touched without danger of shock.

ERNST A. POHLE, M.D., Ph.D.

THE APPENDIX (DIAGNOSIS)

The Roentgenologic Demonstration and Diagnosis of the Appendix. Bruno Thom. Röntgenpraxis, Aug. 1, 1931, III, 673-679.

The roentgenologic diagnosis of diseases of the appendix is still very much disputed. The author undertook systematic examinations, surgery serving as a check in most cases. A more extensive use of the roentgen examination in this field seems justified.

Certain physiologic facts are known about the appendix. The filling of the appendix takes place passively, but it empties itself actively by a contraction of the intrinsic muscles, evidenced by peristaltic waves. Segmentation of the appendix, which can be shown rather frequently roentgenologically, is an indication of active peristalsis, which peristalsis, however, does not correspond to the one of the colon in time and tonus. The normal emptying time of the appendix lies between 18 and 36 hours. A longer time cannot be considered normal, although several authors have come to that conclusion.

Either oral administration of barium or a barium enema leads to a filling of the appendix after careful preparation (castor oil and bland diet). Fluoroscopic observation gives information about the position, mobility, and emptying. Non-filling of the appendix indicates a pathologic condition, but one must admit that even the most careful technic will sometimes miss a temporary filling. Delayed emptying (after 36 hours) indicates an "appendostasis." Of 57 cases with this roentgenologic symptom, only 2 proved at operation to have a normal appendix. Segmentation is a sign of peristalsis. Filling defects and stenotic areas are of significance only when repeatedly observed at the same point. The distal end of a normal appendix is usually round and convex; if one finds it concave or straight, one must think of a fecalith. Fixation of the appendix can be demonstrated only by fluoroscopic observation. The indication for surgery cannot be given by a roentgenologic examination alone, but only in connection with the clinical examination. The sometimes difficult diagnosis of chronic appendicitis can be made easier with the help of the roentgen examination.

H. W. HEFKE, M.D.

ARTHRITIS

Arthritis or Neuritis? William Martin. Western Med. Times, June, 1931, L, 254, 255.

The author stresses the importance of carefully studying every case with complaint of a "twinge of rheumatism" in any one of the joints or in some other region of the body. A

correct diagnosis is absolutely essential for effective treatment.

Pain in or about the shoulder joint may be the result of arthritis, bursitis, neuritis, or perineuritis. In arthritis there is usually pain, redness, swelling, and inability to move the part without an increase in the pain. An X-ray examination is necessary for the diagnosis of bursitis. When arthritis and bursitis are carefully eliminated, neuritis may be considered the probable diagnosis. As a final proof, the static wave current test should be employed. Whenever there is a sore nerve under the electrode, there will be a painful response. The pain may be referred to distal points of nerve distribution. The treatment of this condition is by the static wave current applied carefully and thoroughly.

In the lower extremity, hip joint and back pains are encountered. In neuritis these pains are worse at night and are not relieved by rest, while in arthritis rest results in relief. The articular branch of the sciatic nerve is the one that almost always becomes irritated. It is therefore necessary always to test out the articular area to see whether or not it is involved. Cramps involving the calf muscles may result, and if treatment is administered only to these parts and not to the source and main trunk of the sciatic nerve, failure may result.

Involvement of the knee joint, likewise, should be studied carefully. The X-ray examination will aid in deciding whether the pain results from an arthritis or a bursitis. It is also important to test out these areas with the static wave current. In the treatment, the current should be applied to the nerve course and to the articular branch as well as to the knee joint.

J. N. Ané, M.D.

Results of Sympathetic Ganglionectomy and Ramisectomy for Chronic Arthritis: The Personal Experiences of a Physician. James R. Moore. Jour. Am. Med. Assn., July 18, 1931, XCVII, 172-174.

This is a record of the onset, progress, and treatment of a case of arthritis. In 1926, while in supposedly perfect health, the patient suffered an attack, insidious in onset. It occurred while he was in a country commonly considered favorable as a residence for arthritics, and progressed for a year.

Foci of infection were removed and possible sources eliminated. Hot baths, massage, and ultra-violet radiation failed to hold it. Bilateral lumbar sympathetic ganglionectomy was done in January, 1930. While definite improvement had followed the operation, the hands gradually became more painful and swollen. Disability was so great that the patient requested an operation for the release of the sympathetic control of the upper extremities. A bilateral cervicothoracic sympathetic ganglionectomy and ramisectomy was done in July, 1930, affording considerable relief. The freedom from constant pain, the radical change in mental attitude following such definite improvement, and the return to active service have all been reflected in improved general health. The result more than justified the risk and discomfort necessarily attendant on two such major operations.

C. G. Sutherland, M.B.(Tor.)

THE BLADDER

Primary Carcinoma in Diverticula of the Urinary Bladder. Alexander Hamilton Peacock and Donald G. Corbett. Jour. Urol., June, 1931, XXV, 625-638.

Primary carcinomas in diverticula of the bladder occur more frequently than the literature indicates. The more thoroughly these diverticula are examined, the more frequent are carcinomas found. Diagnosis is exceedingly difficult. Hematuria with a diverticulum as the origin may create a suspicion of the condition. Imperfect filling defects in diverticulograms point to the presence of a tumor, although blood-clot and calculus should be excluded.

When diverticula are associated with prostatic hypertrophy, they should be removed, if large and thoroughly exposed, and inspected in all suspicious cases.

Trans-urethral electric coagulation and radium implantation give questionable results. Total resection is the rational treatment according to the authors' experience.

DAVIS H. PARDOLL, M.D.

Diverticulum of the Bladder, Forming a Scrotal Hernia: Report of a Case. J. William Hinton. Jour. Urol., July, 1931, XXVI, 153, 154.

The finding of a scrotal hernia which has been produced by a diverticulum of the urinary bladder seems of sufficient interest to warrant reporting. The history of the patient having passed a large number of urinary calculi should have called attention to the possibility of the bladder being involved in the hernial mass, and suggests that a cystogram should be done on any patient giving a similar history.

DAVIS H. PARDOLL, M.D.

BLOOD CHANGES

Variations in the Reticulocyte Count in Anemia Caused by Alpha Radiation. P. Lambin and B. Cornil. Compt. rend. Soc. de biol., May 22, 1931, CVII, 264-266.

Anemias caused by X-rays and radio-active substances have been the object of quite a number of experimental and clinical observations. The authors have studied the important hematologic modifications resulting from the radio-activity of ionium. They have experimented on the rabbit, making use of weekly intravenous injections of 1 mg. per kilogram of body weight of an aqueous solution of thorium-ionium nitrate. The animals died within from 13 to 21 weeks, presenting an intense anemia with leukopenia and, in half the cases, a terminal purpura. The leukopenia precedes the anemia, and towards the end there is absolute lymphopenia.

The authors have given especial attention to hematologic signs of blood regeneration during the progress of the anemia, as the presence of these signs in anemias caused by radiation has given rise to so many divergent opinions.

Particular attention is given to the percentage of reticulocytes, which in the pre-anemic stage is quite high, rising from 3 per cent (initial percentage) to 10.9 per cent or from 4 per cent to 16.2 per cent. From this period of reticulocytosis, follows a phase corresponding to the onset of globular decline, when the percentage of reticulocytes falls to, or even below, the initial levels, these low levels sometimes persisting until death. However, in many cases there is a decided increase in the number of reticulocytes, in one case rising from 2.2 per cent to 14.4 per cent during a period of intense anemia, this crisis not preventing a fatal issue.

The reticulocytosis in the pre-anemic phase is comparable to the frequent increase of reticulocytes observed in workmen coming in contact with radio-active substances.

The possibility of an increase of reticulocytes during the terminal stage indicates that the presence of histologic signs of regeneration during a severe anemia caused by radiation does not necessarily carry a favorable prognosis.

It is evident, from the authors' viewpoint, that the menatologic changes observed must be attributed to the ionium and not the thorium, as weekly injections of 5 mg. per kilogram of thorium nitrate during a period of four months have caused neither anemia nor leukopenia, nor relative lymphocytosis, and the reticulocytes have remained within normal limits. On the other hand, since the clinical properties of thorium and ionium are identical, the experiment allows the conclusion that the effects observed must be attributed to the radio-activity of the ionium, in other words, to alpha-radiation.

HENRY BAYON, M.D.

BONE (THERAPY)

A Case of Gas Gangrene. Angus K. Wilson and Beattie Martin. Canadian Med. Assn. Jour., June, 1931, XXIV, 839, 840.

A patient, aged 7 years, had a compound

fracture of the right radius and ulna about an inch above the styloid process of each bone. Following an X-ray examination it was decided to make a reduction by open operation. A plaster cast was applied.

On the second day the patient complained of pain in the region of the forearm, and this, associated with blueness and coldness of the fingers, led to splitting of the cast along the outer side. Relief of pain and improvement of circulation in the fingers led to the belief that the trouble had been due to pressure.

In a few hours the pain returned and morphine was given. The temperature was 101 by rectum, and the pulse rate 100. The fingers became darkly discolored and cold. Pus began to appear in the wound, and the odor of gangrene developed. The forearm became swollen, cold, and almost black. A large gas bleb developed on the radial aspect of the forearm and fine crepitations began to be palpated over the mid-forearm. The temperature rose to 103. Cultures from the pus and fluid showed the presence of *B. Welchii.*

Treatment was complicated by the absence of specific serum. *(Abstractor's Note.*—Every large center should have a supply of anti-gas-gangrene serum for use in these emergencies. In our clinic we have saved many limbs and lives by the prompt use of this serum, which we keep always on hand.) Treatment was further complicated in this case by the lack of unanimity of opinion as to what should be done. Some advised immediate amputation, while others advised awaiting the appearance of a line of demarcation. The latter course was followed. After a very stormy period of about a week, during which time the patient barely escaped exit, the demarcation became sufficiently marked to permit of amputation at the junction of the middle and upper third of the humerus. Recovery was gradual and complete.

L. J. CARTER, M.D.

Compound Fracture of the Left Forearm Complicated by Infection with *B. Tetani* and *B. Welchii*. R. L. O'Callaghan. Canadian Med. Assn. Jour., June, 1931, XXIV, 840, 841.

A male, 7 years old, was thrown from a horse and received a compound fracture of the left radius and ulna. The fracture was reduced and found under the X-ray to be in good alignment. The circulation in the hand was good. Twenty hours later the mother noticed that the hand was cold and cyanosed. On examination both surfaces of the forearm and of the arm up to the middle of the biceps and triceps muscles were found to be crepitant. The wound looked necrotic and an odor emanated from it.

Cultures from the open wound gave *B. Welchii* and *B. Tetani.* Immunizing doses of gas-bacillus serum and anti-tetanic serum were given immediately. The left arm was at once amputated at the level of the insertion of the deltoid muscle. Within twenty-four hours acute tetanic convulsions and all the other symptoms of gas-bacillus and tetanus infection developed. Massive doses of anti-tetanic serum were given during the next five days. In spite of a very stormy illness the patient recovered.

L. J. CARTER, M.D.

BONE DISEASES (DIAGNOSIS)

Anatomic Observations on a Case of Osteopoikilia. G. Schmorl. Fortschr. a. d. Geb. d. Röntgenstr., July, 1931, XLIV, 1-8.

Osteopoikilia is characterized by numerous areas of bone condensation which occur in the spongiosa of all bones except the skull and spine, ranging from pin-head to lentil size. All epiphyses, especially those of hands and feet, are sites of predilection. Kahlstorf recently tabulated all cases which had been reported in the literature (*Röntgenpraxis,* 1930).. To his survey should be added a case recently reported by Awalischwili in the same journal.

A boy, 14 years of age, who died from multiple osteomyelitic foci, amyloid degeneration, bilateral pyonephrosis with calculi and marasmus, affected with this peculiar bone variety, came to autopsy. The findings are reported in

this paper and may be summarized as follows: The foci of condensation characteristic of the picture of osteopoikilia develop in the bone marrow. The origin is probably not of endochondral nature. Their structure is not that of cortical bone but of spongiosa, densely packed, with signs of apposition and absorption. Extensive microscopic study could not give any hint as to their etiology, which is in all probability an anomalous congenital anlage. So far, no sign could be detected which might incriminate these local osteomas as disposing them to other bone diseases and degeneration. The fact that they participate in osteoporosis by inactivity indicates that they are entirely a part of the surrounding bony tissue and have no biology of their own, as some other congenital malformations.

HANS A. JARRE, M.D.

Lipoid Histiocytosis (Niemann-Pick's Disease). H. G. Poncher. Am. Jour. Dis. Child., July, 1931, XLII, 77-87.

In recent years, seventeen cases of lipoid histiocytosis have been recorded. Rowland has attempted to correlate the various clinical manifestations of disturbed lipoid metabolism.

The author reports a case in a Jewish boy, 18 months of age. Roentgen examination of the long bones and of the spine showed evidence of general decalcification, with focal areas of osteoporosis in the long bones. Roentgenograms of the lower extremities showed generalized osteoporosis and transverse lines of disturbance of growth in the metaphyses.

F. B. MANDEVILLE, M.D.

Deformities of the Femoral Head Following Closed Reduction of Congenital Dislocations of the Hip. Ernst Freund. Fortschr. a. d. Geb. d. Röntgenstr., February, 1931, XLIII, 131-168.

The outcome of closed reductions of congenital hip dislocations was studied systemically in a large number of cases by repeated roentgenologic control. The author came to the conclusion that most of the so-called late deformities of the femoral head following the procedure mentioned are developing in immediate succession to the reduction of the congenital dislocation. Two specific types of deformity may be differentiated: An osteochondritic and an arthritic one. These two types have nothing in common, except their inception immediately following the reduction of the dislocation. They often occur combined, but they are merely co-ordinated and not dependent one upon the other. The author assumes a constitutional factor contributing to the occurrence of both processes. On the basis of this constitutional weakness, an aseptic epiphyseonecrosis develops, following the maneuver of reduction of the dislocation, which may entail mild compression fractures of the center of ossification. This epiphyseonecrosis, with its subsequent reorganization, will take the typical course of Perthes' disease. The second type of deformity, the arthritic one, starts with an ustulation of the articular cartilage of the femoral head, which, subsequently, involves the subchondral spongiosa and may lead to the complete loss of the epiphysis for the head of the femur. The final outcome and the roentgenographic appearance of both processes may be identical, so that roentgenograms obtained in the late stages and after termination of the acute processes cannot give any information as to the original etiological factor leading to the deformity. During the early stages, however, the types may be differentiated rather easily by roentgenographic examination, while clinically they may manifest themselves with entirely identical symptoms.

In relation to the advanced disintegration and deformity, clinical symptoms are usually surprisingly mild. It is to be admitted that so-called late deformity in a reduced congenitally dislocated hip may take place, that is, a true Perthes' disease, as well as a true arthritis deformans, may occur in such a hip many years after its reduction. It is to be assumed, however, that in such cases the resulting deformity would be relatively mild, while the severe deformity in immediate succession to the reduction would be attributed to this procedure and

its consequences. It is postulated, therefore, that all cases of closed reduction of congenital dislocation of the hip should be kept under observation and repeatedly re-examined roentgenographically for several years, so that early osteochondritic and arthritic processes may be detected and properly treated.

Incidentally, the author observed that without any relation to arthritic and osteochondritic processes in the epiphysis of the femoral head, in a number of cases of reduced dislocation, one could detect during and following successful closed treatment, two parallel bands of increased lime deposit in the femoral neck close to the epiphysis. These bands are to be regarded as the expression of a temporary disturbance in the physiologic course of enchondral ossification following reduction and immobilization. The distance between these two bands represents approximately the time interval of three or four months between the changes from the first to the second position of immobilization. The distance between the proximal band and the epiphyseal disc represents the time interval between the second phase of the immobilization and the third. These bands are somewhat equivalent to the lines of growth seen during the different stages of healing in rachitis.

HANS A. JARRE, M.D.

Calcified Deposits in Subdeltoid Bursitis. E. B. Mumford and Florence J. Martin. Jour. Am. Med. Assn., Sept. 5, 1931, XCVII, 690.

Codman showed that the subacromial and subdeltoid bursæ were identical and the names synonymous. The bursa is composed of thin walls and contains but little fluid, there being no communication with the shoulder joint. The etiology of subdeltoid bursitis is not clear either as to primary causative factor in simple types or as to subsequent changes which lead to the formation of calcareous deposits about the bursa. Trauma, slight but frequently repeated, or a single severe injury, is the element most universally accepted as the cause.

It is essentially a condition of adult life, seen equally in males and females: in those of sedentary life, and in those of athletic tendencies, and is often bilateral.

The factors leading to the formation of calcareous deposits are not understood. Spontaneous disappearance of the deposit has been noted. The diagnosis of a deposit in subdeltoid bursitis is dependent on the roentgen observations, as these deposits cannot be palpated and the acute symptoms may occur without the presence of a deposit. Although the roentgenogram may show a considerable space between the humerus and the deposit, this does not indicate that the deposit lies within the bursal sac.

The treatment is either conservative (physical therapy) or radical (surgical). Surgical intervention should never be advised until diathermy has been used.

C. G. SUTHERLAND, M.B.(Tor.)

Non-specific Diseases of the Epiphysis in Adolescence. Ernst Gold. Wien. med. Wchnschr., 1930, I, 404-408. Abstracted in Zentralbl. f. d. ges. Radiol., Sept. 19, 1930, IX, 266.

Perthes-Legg-Calvé's disease was properly called osteochondritis coxæ juvenilis and occurs more frequently in boys than in girls, especially between the ages of five and twelve. Roentgenologically there is no atrophy. The epiphysis is flattened and increased in density. The neck of the femur is thickened and shortened. The end-result is always good except for some interference with adduction.

Köhler's disease affects the second or third metatarsals and occurs at any age; there is here a flattening of the heads of the metatarsals. Kienböck's malacia of the carpal lunate occurs most frequently in the second decade and usually follows trauma. The lunate is increased in density and flattened in its proximal-distal diameter. The end-result is often poor because of secondary deforming arthritis. These conditions are explained by Axhausen as an aseptic epiphyseal necrosis produced by embolic circulatory disturbances. They are all benign, and operative interference is contraindicated, except in lunate malacia. Köhler's

disease of the tarsal navicular is often bilateral. It occurs in children varying in age from five to nine. The navicular is flattened, increased in density, and often broken in several fragments. The etiology of this condition is unknown, but there is usually complete restitution after a longer or shorter period. Schlatter's disease of the tibial tuberosity and apophysitis calcanea are apophyseal rather than epiphyseal diseases.

H. C. Ochsner, M.D.

Osteochondritis Dissecans. A Résumé of the Theories of Etiology and the Consideration of Heredity as an Etiologic Factor. George Wagoner and Bernard N. E. Cohn. Arch. Surg., July, 1931, XXIII, 1-25.

In this article the authors pay particular attention to the theories of etiology and the consideration of heredity as an etiologic factor.

They give an excellent résumé of the literature, which runs back 250 years. Many authors have felt that trauma was the causative agent in the production of this condition and many have formulated the theory that only certain types of injury would bring about this condition. They have been unable to produce this experimentally, and in animals, when pieces of cartilage were chipped off, they became reattached in practically every instance. Elongation of the medial tubercle of the tibial spine has been suggested as a possible etiologic factor.

Many other investigators do not consider trauma the causative agent in osteochondritis dissecans. Many authors believe it to be due to disturbance in the blood supply, others to an arthritis and various other causes. In 1887, König first termed it "osteochondritis dissecans." He did not believe it to be due to trauma, but to a dissecting osteochondritis, resulting in the severance of a piece of the joint surface without otherwise causing damage to the joint itself. Some authors consider it to have an embolic origin.

The authors report five cases in which osteochondritis dissecans of the knee joint was found in various members of the same family. They believe, therefore, that heredity operates as an etiologic factor in the occurrence of osteochondritis dissecans. The entire bibliography of this condition is given.

Howard P. Doub, M.D.

Coccidioidal Granuloma: Roentgen Diagnosis. Ray A. Carter. Am. Jour. Roentgenol. and Rad. Ther., June, 1931, XXV, 715-738.

This fungus disease, produced by *Oidium coccidioides,* occurs and is recognized most frequently in the San Joaquin Valley of California, although occasional cases have been seen in many other widely scattered States. Multiple lesions, cutaneous, osseous, and pulmonary, occur. Roentgenologically the pulmonary lesions are often indistinguishable from tuberculosis or blastomycosis, the characteristic findings being marked hilar thickening, parenchymatous infiltration of slight or extreme degree, and miliary nodules or mediastinal masses in about half of the cases. The osseous lesions resemble blastomycosis, tuberculosis, or syphilis. Characteristic lesions are seen in points of bony prominence, such as the malleoli, patellar poles, tibial tuberosity, styloid process of radius or ulna, outer end of clavicle, and along rib margins. They are often predominately destructive, however, with well-marked periosteal reactions. Cutaneous lesions often co-exist as nodular or papular eruptions with or without ulcerations, evacuating sinuses, and deeper abscesses; cervical adenopathy is especially frequent. While the roentgenologist cannot make a positive diagnosis, he may promote the recognition of the disease in these cases submitted to adequate study of the chest and skeletal systems.

J. E. Habbe, M.D.

Multiple Myeloma and Diabetes Insipidus. Mark J. Bach and William S. Middleton. Jour. Am. Med. Assn., Aug. 1, 1931, XCVII, 306-308.

Demonstrable changes in the sella turcica have been established by the roentgenogram in only a minority of the reported cases. Bony

changes in the cranium of other orders than those described by Schüller and Christian have been reported as occurring in association with diabetes insipidus. Gross thickening of the bones of the skull (but without changes in the sella), osteitis deformans, osteitis fibrosa, polycystica, and hyperostosis, in a patient with late syphilis, and cranial metastasis from remote malignant growths have all been associated with diabetes insipidus.

A case of multiple myeloma with associated diabetes insipidus is reported and reviewed.

C. G. Sutherland, M.B.(Tor.)

Cases of Localized Osteitis Fibrosa Recklinghausen of the Inferior Maxillary. Vladimír Hlaváček. Otolaryngol. Slav., July, 1931, III, 308-319.

The etiology of osteitis fibrosa is unknown. It is believed, however, that syphilis, trauma, derangement of endocrine secretion, neuropathic influences, infections, and anomalies in the metabolism of calcium play some rôle in the establishment of this condition. An X-ray examination of the affected region reveals lighter regions which are suggestive of thin tissue, due to softening and resorption of the bone substance.

Osteitis fibrosa usually affects the long bones in the form of limited tumors. Involvement of the facial bones has been noted occasionally. The author reports three cases which showed involvement of the horizontal portion of the inferior maxillary.

The first case was that of a female, 30 years of age, who presented a tumor of the horizontal portion of the inferior maxilla of 15 years' duration. The roentgenogram showed spongious structure with small cavities ranging in size to that of a lentil seed. The tumor, which extended to the angle and partly affected the ramus of the inferior maxilla, was subsequently removed by operation, healing of the wound resulting within eight days' time.

The second case was that of a female, 18 years of age, who suffered from an osseous tumor at the insertion of the masseters. Three years before, the patient had had a suppurative periostitis in the right half of the mandible. After the inflammation had subsided, the tumor had appeared and gradually enlarged. X-ray examination showed a diffuse enlargement in the right horizontal arm of the mandible. Surgical removal of the tumor was subsequently performed.

The third case was that of a boy, 14 years of age, who had suffered from a toothache three months previously. When extraction was attempted, the tooth broke, leaving the roots in the alveolar socket. For a while the pain and swelling disappeared, then a painless enlargement occurred in the same region. The roentgenogram revealed, in the region of the lower first molar, a cavity the size of a walnut into which the unextracted roots were found protruding. The cavity, which was lined by thickened periosteum, healed eleven days following surgical excision. Histologic examination of the removed specimen confirmed the diagnosis of osteitis fibrosa.

J. N. Ané, M.D.

The Etiology of Osteochondritis Coxæ Juvenilis Deformans. Emil Just. Wien. klin. Wchnschr., July 3, 1931, XLIV, 889-892.

The opinions about the cause of juvenile osteochondritis (Legg-Perthes' disease) are divergent. A case which definitely appears to be due to a trauma is described. A boy, fifteen years old, was accidentally shot by his brother. The bullet was shown to be in the neck of the left femur, but was not removed surgically. For five months the boy was able to attend to his duties. At that time he complained of considerable pain and limitation in movement. The bullet was later removed surgically. After some improvement, the pain recurred and repeated roentgenologic examinations showed a gradually developing picture of Legg-Perthes' disease. The most probable explanation is an injury to the nutrient vessels by the bullet, which slowly led to an aseptic necrosis.

In the last few years, the traumatic origin of this disease has an increasing number of followers, and this case must be listed as a confirmation of this theory.

H. W. Hefke, M.D.

BONE DISEASES (THERAPY)

Cystic Tuberculosis of the Bone. Francis F. Schwentker. Am. Jour. Dis. Child., July, 1931, XLII, 102-106.

According to the author, there is no report in the literature of a case of cystic tuberculosis of the bone occurring in infancy; however, he presents a case in a male, one year of age, which showed tuberculous processes in both the diaphysis and the epiphysis. The intradermal tuberculin test was strongly positive to 0.1 mg. of tuberculin, and the Wassermann reaction was positive. A tumor at the epiphysis of the left ulna was aspirated, and about 1 c.c. of thick, white material was obtained. A guinea pig inoculated with this material developed tuberculosis.

The patient was treated by intramuscular injections of sulpharsphenamin, but until his discharge from the hospital three months later there was no visible change in the lesions of the bones.

Roentgenograms showed a cyst-like degeneration of the ulnæ rather definitely localized to the proximal ends of the bones and extending to and beyond the diaphyso-epiphyseal junctions. The left fibula contained two isolated fusiform areas of expansion, approximately 2 cm. in diameter, having the appearance of cysts which had originated in the medullary cavity of the bone, and by expansile growth pushed the cortex outward. The other bones of the skeleton were normal.

Roentgenograms taken seven months and one year, respectively, after admission demonstrated remarkable healing of the lesions. The syphilitic background necessarily complicates this case.

F. B. Mandeville, M.D.

BONE TUMORS (DIAGNOSIS)

Fibrocartilaginous Tumors of the Bone. Charles F. Geschickter. Arch. Surg., August, 1931, XXIII, 215-328.

This is an extremely valuable article, but because of its length it will be impossible to abstract it in detail. Some of the more important features will be brought out.

These tumors include the osteochondromas or benign exostoses, the chondromas or chondromyxomas, and the chondromyxosarcomas, the latter being a form of osteogenic sarcoma containing cartilage. In this study over 500 tumors of the skeleton are included. Taken broadly these three groups of lesions represent different stages of the same pathologic process and may be graded from the more primitive and malignant to the more highly differentiated and benign. The most primitive (the chondromyxosarcomas) being malignant, the chondromas being potentially malignant in their recurrent form, and the osteochondromas being essentially benign, histologically there is no sharp dividing line between these three forms of neoplasms. The basic tissues comprising them (connective tissue, cartilage, and bone) are present in varying amounts in all of these growths.

Osteochondroma.—The osteochondromas or exostoses are benign tumors, usually occurring in persons between the ages of ten and twenty-five years near the ends of the long bones, and forming bony skeletal outgrowths with a thin cartilaginous cap. The symptoms are generally mild and of long duration, averaging over five years. The roentgenogram of the involved bone gives a typical picture in which the characteristic features are a base or pedicle springing directly from the base of the underlying bone without an intervening zone of abnormal osseous tissue and with an overlying expanding cap composed of cartilage, undergoing calcification or ossification. Microscopic examination of the excised tumor reveals normal laminated bone beneath the transitional zone of calcifying cartilage. This is overlaid by a thin strand of fibrous tissue.

The author believes that these tumors are an exaggeration of a normal bony protuberance intended for the anchoring of an important tendon.

In removing such an exostosis, a careful dissection should be done. The periosteum should be dissected free and laid back. The base or pedicle should then be chiseled through and the tumor lifted off entirely. The fibers of the tendon entering the tumor zone should

then be excised above the cartilaginous zone and the remaining portion of the tendon reanchored to the bone. The adjacent fascia and muscles should be sutured over the area. In this present series over 7 per cent of these became malignant.

Multiple Exostoses or Hereditary Deforming Chondrodysplasia.—In this condition there is a multiple occurrence of exostoses in a single patient, accompanied by numerous other skeletal deformities, such as bending and shortening of the bones and widening and irregularity of their metaphyseal ends. This has a definite hereditary factor and has been traced through numerous generations. Bones of the trunk usually are not markedly involved by the disease, although exostoses affecting the spine and ribs are occasionally recorded. In the extremities there is a tendency for a fairly symmetrical bilateral involvement, although unequalness in the length of either arm or leg is not rare.

In the roentgenogram there are typical exostoses of the pedicle or broad-base type, together with widening of the metaphyseal ends of the long bones and deformity with bending and fusion of the bones of the forearm or lower leg.

The prognosis for life in these cases is good. The deformity, however, cannot usually be removed. Two cases of secondary malignant change occurred in this series.

Chondromas or Chondromyxomas.—The typical chondroma is a benign lesion occurring in the small bones of the hands or feet, or about the ribs and spine in patients between the ages of twenty and thirty. In the phalanges of the hand, where this tumor is most frequently located, the growth produces a central area of rarefaction in the affected bone, which in the roentgenogram is visible as an expanded and cystic area within a shell of cortical bone. The symptoms are usually mild and protracted, trauma often being recalled in connection with the initial appearance of the tumor. In this series only four cases of multiple chondroma are recorded, and in every instance there was diffuse involvement of the bones of the hand or foot.

In the roentgenogram the typical chondroma is a small translucent and rarefied area, occurring centrally in the shaft of a small bone. The cortex about the lesion is thinned and expanded, inviting pathologic fracture. There may be some trabeculæ traversing the tumor, but bone production is not a characteristic. The benign chondroma is the most frequent lesion producing a central area of bone destruction in a phalanx. True central chondromas of the long bones are extremely rare, and it is doubtful whether such a diagnosis is justified on the basis of the roentgenogram alone.

The outstanding characteristics in the gross specimen of neoplasms composed primarily of cartilage are the lobulated and gelatinous character of growth. The tumor is always composed of numerous pockets marked off by visible fibrous trabeculæ, and within the pockets there is a typical translucent and congealed substance of more or less rubbery consistency, which under the microscope can be identified as cartilage. Under the microscope the bulk of the benign chondroma is composed of fairly normal adult cartilage. It shows a matrix of hyaline material divided into lobules by acellular strands of connective tissue. The cartilage cells lie in pairs or tetrads in small lacunæ, and the nuclei, which readily undergo pyknosis, are surrounded by generous amounts of cytoplasm.

Embryologically, there are free cartilaginous strands of connective tissue formed around the joints which normally undergo mucoid regressive changes to form the synovial lining of joint cavities. However, adherent persisting strands which do not thus regress are responsible at a later date for the origin of cartilaginous islands in the bones, which form the chondromas and chondromyxomas.

If these tumors cause no symptoms, they are best let alone and kept under observation by repeated roentgen examination. If they are subjected to trauma or produce symptoms, their complete surgical removal should be undertaken, if this is feasible and the tumor is not too large. They should be curetted out thoroughly and cauterized either by heat or chemically with 50 per cent zinc chloride, and if carefully done, there should be few recur-

rences. When a previously quiet tumor shows sudden signs of increased growth with an exacerbation of symptoms, immediate and complete removal is indicated, as secondary malignant change is to be expected.

Primary Chondromyxosarcoma.—This is a very malignant tumor, arising periosteally, which does not at the onset involve either the cortex or the medullary cavity of the bone. It usually occurs in patients under thirty. The favored sites for this lesion are about the knees and at the shoulder and pelvic girdles. Pain is the most prominent symptom and may interfere with the function of the joint. The examination reveals swelling in the region of the flexed joint and tumor with a rubbery consistency that is larger to palpation than the X-ray film would seem to indicate. Pathologic fracture is rare.

Roentgenologically, the faintly visible and translucent shadow of the soft part of the tumor is seen next to the bone. The adjacent periosteum is usually elevated, and there is frequently absence of cortical or medullary involvement of the bone. When new bone production is present, it is always sparse and has the tendency to take the form of finely radiating lines at right angles to the cortex. When it does involve the medullary portion of the bone, it is more likely to cause bone destruction than sclerosis.

At biopsy the periosteum is found to be raised and perforated, and there is a pearly gray, shiny substance varying in consistency, some of which is well-formed cartilage, other parts, cystic and hemorrhagic. The various lobules that compose the tumor show a tendency to extend lengthwise up and down the bone and around it, rather than to invade the marrow cavity. One of the striking features of this tumor growth is the metastasis or gradual extension into the large vein. Under the microscope there is a composition of loose myxomatous connective tissue merging into zones of fetal cartilage and chondral areas, with an abundant hyaline matrix fringed by osseous tissue.

Permanent cures, even when amputation is performed promptly without a previous exploration, are rare in this malignant form of primary chondrosarcoma. The average duration of life after operation has been about fourteen and one-half months. Neither the location nor the age greatly influences the ultimate results. The author considers radiation therapy only as palliation, but he suggests the use of a radium pack in combination with operation.

Secondary Chondrosarcoma.—In all the benign tumors of the fibrocartilaginous group, the persistence and functioning of the connective tissue of the embryonic cartilaginous type make possible the origin of secondary chondrosarcoma, which is superimposed on the original benign growth. In some such, evidence of the pre-existing growth can be seen, and in others no symptoms are apparent until it has undergone malignant degeneration.

Their greatest incidence is between the ages of forty and forty-five. There is a tendency for these to occur at the upper end of the humerus, in the ribs, and at the heel. The history of trauma can sometimes be elicited, but usually the injury relates to the original benign growth.

In the roentgenogram the most typical picture is that which shows the primary lesion persisting in the X-ray film, and in which the superimposed malignant change is visible as a fuzzy infiltrating periosteal shadow. In advanced cases, the entire tumor site becomes the seat of an infiltrating granular mass in which scattered elements of splintered osseous material may be seen. The destruction of the cortical bone with invasion of the medullary cavity follows, and pathologic fracture may occur.

It is rather difficult pathologically to differentiate these malignant lesions from the benign cartilaginous tumors from which they arise and to recognize them as secondary forms of chondrosarcoma as distinguished from the primary form.

The results of the study of this series show 24 per cent five-year cures. Of these twelve patients, eight were treated by radical resection or amputation. The others were treated by local operative procedure followed by radium or X-ray therapy. Radium appears to

be effective in this form of sarcoma in which complete eradication of the tumor cannot be accomplished by radical resection or amputation. In some cases there have been a number of recurrences before ultimate recovery was achieved.

HOWARD P. DOUB, M.D.

CANCER (DIAGNOSIS)

Recent Work on the Sero-diagnosis of Cancer. Jacques Lavedan. Paris Méd., March 21, 1931, XXI, 261-272.

In this valuable paper are gathered together and discussed fourteen tests for the sero-diagnosis of cancer, all of which have been described by various authorities since 1925. These tests are divided into the following: (1) Chemical or chemico-physical, and (2) biophysiologic. Eight of the tests described belong to the former group, and six to the latter.

Of the chemical and chemico-physical tests, some, notably that of Botelho, can give excellent results in skilled hands. This reaction depends upon the fact that the serum of a cancer patient is more easily precipitated by iodine in an acid medium than that of a normal individual. The biophysical reactions depend upon the not illogical supposition that the serum of cancer-bearing patients contains specific anti-bodies to the cancer cell. On the whole, these reactions have not proved reliable. Apart from the errors arising in technic, all these tests are complicated by the fact that positive reactions may be given in pregnancy, or that positive reactions are given only in advanced stages of the disease. The author quotes Ménetrier, who truly says: "It is as illogical to seek for a single specific reaction in cancer . . . as to seek for a single cause of cancer in all its forms and manifestations."

WALTER M. LEVITT, M.R.C.P., D.M.R.E.

CANCER (THERAPY)

Treatment and Care of a Case of Deep Recurrence of Cancer of the Skin. Daubresse-Morelle. Bruxelles-Med., May 24, 1931, XI, 889.

The author reports the case of a cancer of the skin of the frontal region, which had been treated by excision followed by grafting. Recurrence followed, and the bone seemed affected. Radium was applied with apparently good results, but healing did not continue, and violent pains occurred. Electrocoagulation was resorted to after excision of the diseased tissues with the electric knife. The healing of the case was completed by grafting. In discussing the case, Ferond suggests the advisability of beginning treatment in such instances by electrocoagulation.

HENRY BAYON, M.D.

Radium Treatment of Carcinoma of the Larynx. L. Halberstaedter and A. Seiffert. Strahlentherapie, June 13, 1931, XLI, 73-76.

This is a brief preliminary report of the results obtained in carcinoma of the larynx with a method inaugurated by Ledoux, in 1924 (radium applied through an opening cut in the cartilage). Finzi and Harmer have used it during the past few years, and Halberstaedter described the technic in *Strahlentherapie*, XXXII. The previous dose of 7 mg. in .5 Pt. over seven days was increased to 10 mg. in 1.0 Pt. and even to 15 mg. radium. The tumors responded better to the higher doses. Thirty-one cases could be observed for from 12 to 23 months. Five advanced cases died, one with glandular metastases is still alive after 23 months, one died from pneumonia, two were cured after operation, three had tracheotomy and are still well, one healed with stenosis (requiring tracheotomy later), one healed without tracheotomy. In eight cases, necrosis developed following the treatment. The remaining 17 patients had hardly any reaction, and the lesions healed well. The question arises as to whether the trauma caused by the cutting of the opening does not aggravate the condition. This possibility is further investigated in the writers' clinic.

ERNST A. POHLE, M.D., Ph.D.

New Thoughts about the Fight against Carcinoma. Paul Rosenstein and Hans Köhler. Med. Klinik, July 24, 1931, XXVII, 1095-1098.

Radical surgery must as yet remain the treatment for all operable carcinomas. X-ray and radium are the only other reliable weapons against cancer, especially in carcinoma of the cervix, tongue, and skin. All other methods of treatment heretofore proposed have not been proven successful. The experiments and clinical trials of the authors rest on biologic considerations. One of the main causes for cancers must be the difference between the age and youth of an organism. In the young individual there must be substances which prohibit the growth of a carcinoma which are absent in aging individuals.

Experiments with extracts of the genital glands, the thymus, and the hypophysis have not been successful in the authors' experience, and according to literature. The bone marrow is known to show definite changes with advancing age, especially the marrow of the long bones, which changes from the red to the yellow type. The function of blood formation is not the only one and it could be demonstrated that it possesses other functions of internal secretion. It is known that potassium is the only radio-active element in the body which is able to emit beta-rays. The amounts of radiation energy emitted by potassium in tissues is so small that it cannot be measured by the present-day photochemical and biologic methods. To decide the question if potassium might play a rôle in the genesis of cancer, the content of the bone marrow was experimentally determined. It seems definite that the potassium content is high in the growing individual, that it is only one-fourth or one-fifth of that amount in adults, and that it lies between these two values in individuals with carcinoma. If this holds true in a larger series, it would mean that potassium is needed in a growing individual and also for the growth of a cancer. A hormone might be responsible for normal growth in the child, which is possibly absent in carcinoma patients. The bone marrow must be partly responsible for growth, as it is evident from an experiment on a three-month-old goat in which the marrow of the femurs was removed surgically; the animal has grown very little since that time. This observation had not been made previously. In consequence of the findings, some inoperable cases of carcinoma were treated.

One can try to reduce the amount of potassium in the body by removing the marrow of the long bones or by injecting extract from the marrow of young subjects, or one may transplant such marrow. Six cases are reported which were treated. Critical evaluation of the results (for three years) seems to show that very advanced carcinomas have recovered remarkably by such treatments. The life of the patients was apparently definitely prolonged. At three different times definite regressive changes could be shown, and once the tumor disappeared entirely (cancer of the rectum). The results were so remarkable that the authors wish to publish their ideas without considering them as final, and that they may invite further studies in this field by others.

H. W. Hefke, M.D.

Carcinoma of the Breast in the Young. Burton J. Lee. Arch. Surg., July, 1931, XXIII, 85-110.

Cancer of the breast in young women is a much more menacing disease than it is in middle or in old age. The course is often dramatic in its rapidity, almost simulating an infectious process. When the first symptoms and signs are a diffuse enlargement of the breast, pain, or a redness overlying the mammary gland, surgical intervention is futile. A more careful examination of younger, as compared to older, women must be exercised before radical operation is undertaken. Early recurrence is more frequent in younger than in older women, and indicates either a poorly chosen case for surgical intervention, poor surgical technic, or both. In 143 patients, 20 per cent were alive in two years, and 10 per cent in five years.

In treating these patients, a careful examination should be made. If the breast is largely occupied by tumor tissue, if the axillary nodes are extensively invaded, or if there

are one or more cutaneous nodules overlying the tumor in the breast, the case should be considered inoperable. If, however, there is a tumor of only small or moderate size in the breast without invasion of the axillary nodes, or with but one or two palpable nodes, radical amputation would seem the proper course to follow.

Before surgical intervention is undertaken, the patient should be treated adequately by irradiation, a cycle of high voltage roentgen treatment being given over the breast and drainage areas. If the tumor is radiosensitive, regression will follow in three or four weeks. If the tumor is of the radioresistant type, the degree of regression will be less marked, or there may be no diminution in size. Lee believes that devitalization of mammary cancer requires the equivalent of 10 full erythema doses throughout the tumor, and he and his co-workers are attempting to supplement the high voltage roentgen therapy with interstitial radiation furnished by the insertion of gold radon seeds directly into the mass. The axilla is treated in a similar manner. Radical amputation is performed in from four to five weeks after the insertion of the radon, and histologic studies have revealed in many instances almost complete devitalization of the tumor. At present they are not using post-operative irradiation in these cases, in order to determine the adequacy of pre-operative irradiation.

A similar procedure is followed in patients in whom the disease has passed beyond the stage of operability. If an ulcerating mass is present, a palliative mastectomy is often done one or two months after the completion of adequate irradiation. This operation should never be attempted if tumor tissue stretches continuously from the breast to and into the axilla.

HOWARD P. DOUB, M.D.

Some Observations on the Radiotherapy of Cancers Developing on the Scars of Burns. S. Laborde. La Presse Méd., Aug. 5, 1931, XXXIX, 1168.

The author refers to six cases with epitheliomas arising in the scars of burns. These cancers had developed, after intervals varying from 26 to 58 years, from injuries received in infancy. The author stresses the great difficulty in treating these cases by radiation, comparing their radioresistance with that of epithelioma developing upon a chronic radiodermatitis.

WALTER M. LEVITT, M.R.C.P., D.M.R.E.

An Evaluation of Agents that Destroy or Remove Malignant Disease. A. C. Scott. Jour. Am. Med. Assn., Aug. 8, 1931, XCVII, 385-389.

Low grade cancers coming within Broders' classification 1 and 2 are, with few exceptions, easily destroyed by ample dosage of any agent capable of destroying living tissue. Though disappointing in a large measure, X-rays and radium have a field of usefulness. There is little doubt but that roentgen rays may inhibit active cancer growth and thereby prolong life. Certainly they may be of great physiologic value in the treatment of many hopeless cases.

In certain locations where wide surgical excision cannot be accomplished, radium has a distinct field. The best results in cancer of the uterus and the vault of the vagina are obtained when the low-temperature Percy cautery is heroically used, followed by large doses of radium. Surgical removal by wide excision with the scalpel has proved beyond a reasonable doubt the most exact and dependable of all single agents for the destruction of cancer. Intense heat has been used with varying success and failure throughout the centuries. Three excellent electrical devices giving better control of heat are the Percy cautery, the Downes loop cautery knife, and the diathermy, endotherm, or radio knife. The heat in the Downes loop cautery knife is under most perfect control.

While cancer may be destroyed by various chemical agents, or by radium and roentgen rays, serious difficulties arise from inability to measure sharply or control accurately the depth of penetration and destruction of tissues involved in the disease. In the light of our

present knowledge, surgical removal gives the best possible chance for permanent cure of cancer, and the utilization of intense heat under perfect control by means of the electric loop knife augments the efficiency of surgery to a degree hitherto unknown.

C. G. SUTHERLAND, M.B.(Tor.)

A Study of 210 Cases of Carcinoma of the Rectum and Anal Canal, Treated between 1914 and 1925, Inclusive. Bernard F. Schreiner and Joseph P. O'Brien. Am. Jour. Roentgenol. and Rad. Ther., May, 1931, XXV, 654-658.

Carcinoma occurred in the rectum in 4 per cent of all cases of malignant neoplasm admitted to the Institute for the Study of Malignant Diseases. The authors believe only from 25 to 32 per cent of these tumors to be operable when seen. Irradiation, on the other hand, is applicable to a much larger group of cases and may often eradicate the disease as completely as surgery. Seventeen per cent of operable cases in the series reported on have remained well for five years or more, and 22 per cent have survived for five or more years.

Alternating constipation and diarrhea, bloody and mucous discharge, ribbon stools, and cachexia are not symptoms of early, but of late, involvement in cases in which there is little hope of cure. In the early stage there may be only an increased tendency toward constipation, when such was not previously the case, or two or three stools a day, when such was not the habit.

One hundred eighty-one cases were biopsied: 152 showed adenocarcinoma; 15, epithelioma; 8, colloid carcinoma; 5, papillary adenocarcinoma, and 1, gelatinous carcinoma. The majority of such tumors remain localized for a considerable period of time, except in cases of young adults, in which the spread is invariably rapid.

Up to 1920, the cases were treated with radium needles and low voltage roentgen rays; in 1921, the use of emanation was begun, and in 1922, high voltage roentgen therapy was commenced. Since 1926, the therapy has been more intensive with the rays more heavily filtered, but none of these cases can be reported on yet, since the five-year period has not elapsed. Surgery has been used only to relieve obstruction.

Results were classified according to the extent of the disease at the time of therapy. In Group 1 (local tumors confined to the wall of the canal or rectum and fairly movable), 17 per cent were well five or more years. In Group 2 (infiltrated cases, inoperable), 1.4 per cent were well five or more years. Thirty-nine per cent had palliation for from one to four years. In the group with wide-spread metastases, all died, although some had temporary palliation.

J. E. HABBE, M.D.

Considerations Concerning the Curietherapy of Cancer of the Uterine Neck. Osvaldo Prestini. Rev. Méd. Cubana, September, 1931, XLII, 1040-1049.

The author presents here a good outline of the treatment of cancer of the neck of the uterus with radium. After considering all the different methods, he concludes that the one giving him the best results is that of Regaud. This method consists of one application at several foci, usually six, with small doses over a longer period of time. He uses 60 millicuries for six or seven days.

N. G. GONZALEZ, M.D.

Radiotherapy and Curietherapy of Internal Cancer. Francisco Dominguez. Rev. de méd. y cirug., June 30, 1931, XXXVI, 402.

In this article, the author presents the views of Dr. Proust. He divides the subject of treatment according to whether the lesion is superficial or deep.

It is his belief that the best treatment for superficial lesions is X-ray, due to the fact that it is available in most clinics. For deep-seated lesions, radium is preferable when it can be

applied directly to the organ, such as in the case of the cervix or bladder, since X-rays have to go through many tissues before they can have a direct action. He believes that surgery has had just as good results as radiotherapy in carcinomatous lesions of the gastro-intestinal tract and that both treatments combined are indicated in some cases. It is also his belief that the cellular variety of the lesion determines whether X-ray or radium should be used.

On considering the genito-urinary tract, the author states that seminomas respond wonderfully to X-ray therapy, while in the bladder and prostate, radium is preferred. In cancerous lesions of the hypophysis, X-ray gives excellent results. In treatment of lesions of the uterus, radium is supreme over any other treatment.

N. G. GONZALEZ, M.D.

The Biological Treatment of Cancer. Francisco Dominguez. Rev. de méd. y cirug., June 30, 1931, XXXVI, 407-411.

This treatment is directed principally to the general condition of the patient, and its object is to inhibit the growth of cancer. The author believes that since cancer cells develop from other cells in the body, there must be a way of producing immunity. His theory is based on the well-known regression of some cancerous lesions.

He considers here the treatment by limiting the intake of sugar, by producing erysipelas on the cancerous lesions, vaccines, sera, autogenous sera, *et cetera.* He concludes that the results of these methods have always been disappointing but that we must not despair of discovering some substance which, when injected, will bring about regression of cancer cells.

The author presents the views of Rubens Duval.

N. G. GONZALEZ, M.D.

Our Preliminary Experience with Protracted Fractional Roentgen Treatment in Female Genital Carcinoma. R. Schröder. Strahlentherapie, June 13, 1931, XLI, 67-72.

At the Women's Clinic of the University of Kiel, the preliminary impressions gained with the Coutard method in the treatment of 40 cases of carcinoma of the cervix and uterus are discussed by the chief of the service. As a rule, 180 K.V., 2.3 mm. copper at 4 ma., and 50 cm. F.S.D. were employed (H.V.L. in copper 2.0 mm.), 5 to 6 r per minute. Sometimes 170 K.V. and 1.5 mm. of copper (H.V.L. in copper 1.5 mm.) at 3 ma. and 50 or 70 cm. F.S.D. were used. The exposure took place through one or two anterior fields and two posterior fields of 10×15 cm. or 15×20 centimeters. The first series of patients received one or two fields per day, later groups only one field per day (200 r in air), the total dose applied amounting to 2,000 r per field given over a period of 30 or 40 days.

The cases were selected as follows: (1) All patients who developed a recurrence after operation or radium treatment in a location which could not be reached by either radium or operation; (2) advanced cases which had received three times 2,000 mg. radium at intervals of from one to three weeks, if infiltrations were found beyond the radius of action of radium; (3) advanced cases as mentioned above, but without preliminary radium treatment; (4) post-operative irradiation in cases without recurrence or patients who had been successfully treated with radium.

The systemic reactions of not too cachectic patients were very mild; the leukocytes did not drop much below 6,000, the hemoglobin from about 5 to 10 per cent. Very severe reactions were seen in advanced cases which were in poor general condition. In some of these, the treatment had to be discontinued. The skin showed a typical epidermitis sicca or exudation. After six months the fields were pigmented, but no ulcers or necrosis were seen. The skin over the sacrum had been protected during irradiation. The rectum and bladder showed slight disturbances (diarrhea and tenesmus) but no ulceration. There were no bone reactions.

Very little can be said at this time about the reaction in the tumor. Undoubtedly there was

definite pain in the carcinoma, particularly on the second to fourth days, but after from 8 to 14 days this had disappeared completely. Large lymph glands often reduced considerably in size. Occasionally, necrosis of the tumor tissue occurred, and this sometimes required surgical incision. It is concluded that although no statistics as to permanent results can be submitted at present, the preliminary results were sufficiently encouraging as to warrant continuation of this treatment method, probably with still higher doses.

ERNST A. POHLE, M.D., Ph.D.

Cancer of the Ear. Ricardo Silveira. Rev. de méd. y cirug., June 30, 1931, XXXVI, 443-445.

The author presents here a case of cancer of the middle ear. He attempted to remove it *in toto* but was unable to do so because of the extensive hemorrhage. The pathologic report on the tissue was carcinoma—epidermic in origin. Due to the condition of the patient, the treatment consisted entirely of radium.

N. G. GONZALEZ, M.D.

Present Views Concerning the Treatment of Cancer. Francisco Dominguez. Rev. de méd. y cirug., June 30, 1931, XXXVI, 389.

This is a section of an extensive paper. The author believes that there should be a 100 per cent cure in this type of lesion, since cancer and pre-cancerous lesions can be diagnosed early. He goes into detail about the different lesions, such as nevus, pigmented keratomas, Paget's, Bowen's, and Broi's diseases, epithelial degeneration following lesions caused by X-ray, etc. He also discusses the different treatments used, the most outstanding methods, in his opinion, being X-ray, radium, and electrocoagulation.

The author here presents the views of Professor Roussy, of Paris. He divides the problem into etiology, pathogenesis, and biology. He attributes the knowledge of etiology to experimental cancer as produced by X-ray, irritating substances, etc., and goes into detail to explain how X-rays have shown an individual, as well as a racial and special, predisposition to cancer. Concerning the pathogenesis, he admits that it is entirely unknown but that the predominating theories are the parasitic and cellular ones. As to the biology, he states that at its onset cancer is localized, but that it eventually affects the whole system—it being our problem to find out in what way, by chemical and physico-chemical analysis.

The treatment consists of the following; (1) Removal *in toto* of the tumor, whether by surgery, cautery, or diathermy, and (2) the use of X-rays and radium. The author goes on to show what types should be treated by removal and which ones by X-ray or radium and how the amount of irradiation is of vital importance, because radiation therapy is based on radiosensibility of the tissues and their component elements. He believes that the effect of irradiation is indirect through some substances in the circulating blood, most probably contained in the lymphocytes.

N. G. GONZALEZ, M.D.

CATHODE RAYS

Effect of Irradiation on Cathode-ray Reflection at Aluminum and Platinum Surfaces and the Reality of the Positive and Negative Currents Thereby Produced. W. Kohl. Ann. Physik, 1930, VI, 391-407.

The effect of irradiation on the reflection of cathode rays at Al and Pt surfaces is to produce currents of two kinds. The total radiation is either greater or less than the sum of the single components, *i.e.*, the thermo-electric and the photo-electric currents. It can be shown that the diminution in the total current observed by Frey when a foil was simultaneously emitting electrons and being radiated with ultra-violet light in a homogeneous field is dependent only to a small extent on the velocity of the primary electrons, but to a much greater extent on the gas content of the foil. Foils containing gas can give rise to a positive addition current in a homogeneous field, a fact which is explained by the diminu-

tion of the space charge effect. This positive addition current may amount to 50 per cent of the photo-electric current according to the conditions of the experiment. It is possible to obtain currents of greater strength than the photo-electric current if the field is not homogeneous and the foil is free from gas.

CHEMICAL ABSTRACTS.

The Cathode Fall of an Arc. R. C. Mason. Phys. Rev., Aug. 1, 1931, XXXVIII, 427-440. (Reprinted by permission.)

The distribution of energy of electrons at the boundary of the cathode fall of an arc is worked out for the thermionic arc and for the high field arc upon both the classical Schottky theory and the quantum mechanical theory of high field emission. For the same value of cathode fall, the electrons from the thermionic arc have energies several volts greater than those from the high field arc. To give the positive ions necessary for space charge purposes, the cathode fall of the high field arc consequently must be several volts greater than that of the thermionic arc, if the mechanism of production of positive ions is the same in the two arcs. The minimum value of the difference in cathode fall is from 4 to 6 volts. Tests are thus suggested for Langmuir's high field theory of cold cathode arcs. Data for the mercury arc indicate that electrons, in sufficient number to produce the necessary positive ions, have energies certainly less than 7 volts at the boundary of the cathode fall. Either the field theory does not apply to the mercury arc, or positive ions are produced by a cumulative process or other complicated means.

The Specific Cathode-ray Effect Obtained by High X-ray Doses. H. and M. Langendorff. Strahlentherapie, June 13, 1931, XLI, 135-141.

Politzer and Pauli described typical changes in mitosis of salamandra larvæ following cathode-ray exposure. With a special roentgen apparatus (output 1,120 r per second), doses of from 1,600 to 800,000 r were given to larvæ of *Axolotl.* Since identical effects could be observed as by the above mentioned investigators, the changes described by them cannot be specific for cathode rays but occur after the application of electronic energy of a certain order of magnitude.

ERNST A. POHLE, M.D., Ph.D.

CHEMICAL

Diffuse Scattering of X-rays from Sylvine. G. G. Harvey. Phys. Rev., Aug. 15, 1931, XXXVIII, 593-603. (Reprinted by permission.)

By means of the formulas recently obtained by Compton for monatomic gases and by Jauncey and Harvey for simple cubic crystals, f' values can be calculated from the observed intensities of the diffuse scattering. The formula for crystals is valid only for the case in which the crystal consists of atoms of one kind. Up to the present time, the only crystal for which S values were known was rock salt, but this is a crystal consisting of two kinds of atoms. Sylvine, however, is a crystal consisting of one kind of atom, since the ions K^+ and Cl^- may be considered as argon-like atoms.

In the present research S values have been obtained for sylvine at room temperature. If these S values are plotted against $(\sin \phi/2)/\lambda$, an S curve is obtained similar to that obtained by Jauncey and May for rock salt, as described by Jauncey and Harvey. Comparing the S curve for sylvine with Wollan's S curve for argon, the two are tangent at $(\sin \phi/2)/\lambda = 1.05$ and beyond this appear to merge. From the formula of Jauncey and Harvey, f' values for sylvine have been calculated, using F values obtained by James and Brindley. Plotting the f' values for sylvine and those obtained by Wollan for argon against $(\sin \phi/2)/\lambda$, both sets of points fall on the same curve, the agreement being remarkable. Comparison is also made of these f' values with the theoretical f values obtained for a Schroedinger atom by James and Brindley. The agreement is good

out to $(\sin \phi/2)/\lambda = 1.0$, but from there on the theoretical f curve falls off too rapidly. It might be expected that the theoretical f curve would fall off too slowly since f' is less than f. In this region the agreement between theory and experiment could be improved.

Photochemistry of Ergosterol. E. H. Reerink and A. van Wijk. Strahlentherapie, May 20, 1931, XL, 728-732.

Animal Experiments with Irradiated Ergosterol. J. van Niekerk and J. W. R. Everse. Strahlentherapie, May 20, 1931, XL, 733-738.

The authors found that a substance L is produced in ergosterol following exposure to λ =3,000 Å. to 2,840 Å.; after further irradiation a new substance S appears. Studies of absorption spectra lead them to believe that L is identical with Vitamin D.

In the following paper, van Niekerk and Everse report their biologic tests with the L and S substances. They found that substance L, which is well characterized by its absorption spectrum, has a strong Vitamin D effect. There is no reason, however, to ascribe an anti-rachitic effect to substance S.

ERNST A. POHLE, M.D., Ph.D.

Effect of Temperature on the Intensity of X-rays Diffusely Scattered from Rock Salt. W. D. Claus. Phys. Rev., Aug. 15, 1931, XXXVIII, 604-617. (Reprinted by permission.)

P. Debye has predicted that X-rays diffusely scattered from simple cubic crystals should decrease in intensity by a factor $(1-e^{-M})$ as the temperature decreases. M is a quantity depending on the characteristics of the crystal, wave length of the X-rays used, and the angle of scattering. Later, Waller's modification of the Debye factor, namely, that the exponent should be $-2M$, enjoyed some experimental success in regular reflection. Quite recently, Jauncey and Harvey have announced an entirely new formula (in which diffuse scattering and regular reflection are shown to be complementary) for predicting the change in intensity of diffuse scattering with temperature, from the known temperature effect on atomic structure factors.

The present research was undertaken: (1) to establish the effect of temperature on diffuse scattering from rock salt as an experimental fact over a wide range of temperature from 120°K to 750°K; (2) to attempt to distinguish among the three predicted values. An ionization method was first used, but was found to give erratic values at the larger scattering angles. A photographic method gave the following ratios of intensities between 120°K and 300°K: 28°, 0.58; 35°, 0.64; 45°, 0.68; 58°, 0.79. Between 750°K and 300°K, the ratios were: 28°, 1.20; 35°, 1.26; 45°, 1.23. At the smaller scattering angles, these ratios agreed with those obtained by the ionization method. The effect of temperature was thus established as an experimental fact. On comparison with the various theories, it was found that the Debye theory is definitely precluded. At low temperatures, the agreement appears to be with the Waller modification of Debye's theory, when zero point energy for the atoms of the crystal is included. At the high temperature, the agreement is with the formula of Jauncey and Harvey. A discussion of these results leads to the conclusion that the agreement with the Waller theory at low temperatures is probably fortuitous, and that the formula of Jauncey and Harvey probably predicts more closely the ratios for sylvine, to which the formula is more strictly applicable than to rock salt.

Matter and Vibration: Diffraction of Electronic Vibration. A. Sommerfeld and F. Kirchner. München. med. Wchnschr., Aug. 7, 1931, LXXVIII, 1348-1350.

Laue and his co-workers have established the nature of the X-rays. The latest discoveries of Schrödinger, Davisson, and Germer have shown the mechanism of electronic vibration in matter and have compared it with the process of X-ray diffraction. It can be demonstrated on a bi-dimensional crystal grating of, for instance, a mica plate of several hundred

thousandth millimeter thickness. The triangular array of the points of interference corresponds to the atomic structure of the mica. If the thickness of the plate is increased, the lines of diffraction from the different planes produce concentric rings (Debye-Scherrer diagram). Such diagrams can also be obtained by substituting for the mica similarly thin layers of cellulose or colloid substances (Thomson). This has led to the discovery of the structure and the more or less regular arrangement of the atoms in cellulose and numerous colloid substances.

ERNST A. MAY, M.D.

Study of the Structure of Plastic Sulphur. J.-J. Trillat and J. Forestier. Compt. rend., 1931, CXCII, 559-561.

Plastic S, prepared by heating S to above 230° and pouring into cold H_2O, stretches upon rapid drawing to a permanent lengthening of 800–1000 per cent, and at the same time its physical properties (transparency, elasticity, etc.) are changed. Examination shows that the S was amorphous before drawing, and crystalline after, but the crystalline structure was not the same as that of ordinary orthorhombic S. Resemblances of this behavior to that of rubber or cellulose are pointed out. X-rays also activate recrystallization of the plastic S.

CHEMICAL ABSTRACTS.

Properties of Irradiated Trypaflavine and Some Irradiated Dyes. R. Dujarric de la Rivière, Etienne Roux, and Françoise Cavallier. Compt. rend. Soc. de biol., Feb. 13, 1931, CVI, 346-348.

This is an interesting study of ultra-violet radiation of trypaflavine and some dyes. For the sake of simplicity and abbreviation, irradiated trypaflavine is referred to as "radiocridine."

1. *Experiments in Vitro.*—These consisted in irradiating for 10 minutes in one experiment and 20 minutes in another, a solution of trypaflavine 0.005 gr. to each c.c. of the solution, usually employed in therapeutics, and the effect of incubating a meningococcus emulsion with this solution for 24, 48, and 72 hours. Control experiments were made with trypaflavine, not irradiated, and results compared, showing the undoubted antiseptic property of "radiocridine" on the meningococcus.

2. *Experiments in Vivo.*—The same solution of trypaflavine 1 c.c. = 0.005 gr. was irradiated for 15 minutes and rabbits injected a half-hour after irradiation. Rabbits receiving injections of meningococcus and trypaflavine died in two or three hours, whereas, those injected with meningococcus and "radiocridine" lived a much longer time (24 hours), or recovered completely.

Several dyes were submitted to ultra-violet rays. The blues alone seemed modified, their coloring becoming deeper, a sort of maturation of color which is usually obtained only with aging.

HENRY BAYON, M.D.

Photo-electric Properties of Zinc Single Crystals. J. H. Dillon. Phys. Rev., Aug. 1, 1931, XXXVIII, 408-415. (Reprinted by permission.)

An experiment is described in which the photo-electric properties of outgassed single crystals of zinc were studied. After treating the emitting surfaces of a crystal with ultra-violet light and thermally evaporating some of the zinc, a stable condition was reached. In this stable condition a difference in the long wave limits of the poly-crystalline surface and cleft 0001 face of approximately 260A was observed. The results are discussed with regard to possible sources of contamination and the presence of occluded gas layers.

Selective Thermal Radiation of Colored and Pure Fused Quartz. R. W. Wood. Phys. Rev., Aug. 1, 1931, XXXVIII, 487-490. (Reprinted by permission.)

Thermal Radiation of Fused Quartz.—The peculiarity of pure fused quartz in that it does not visibly radiate at all until its temperature

nears the fusion point is explained by the displacement, with increasing temperature, of the ultra-violet absorption band toward the visible.

Selective Thermal Emission of Neodymium Oxide Dissolved in Quartz.—Quartz-neodymium rods, containing neodymium oxide, were prepared. When heated they emit a radiation consisting of seven distinct bands. The wave lengths of the centers of the bands are 8730, 8270, 7504, 6717, 5944, 5340, 4570 Å. Absorption measurements show bands in the same positions. A method for preparing the neodymium-quartz is described.

Chemical Decomposition by Radiation. The Action of X- or Gamma-radiation on Living Tissue Compared with the Production of an Image from a Photographic Film. G. Harker. Jour. Cancer Research Committee, University of Sydney, May 1, 1931, III, 28-34.

Interesting analogies are drawn between the action of light on a photographic plate and the action of X- and γ-rays upon tissues. Many of the important effects of light are due to chain reactions whereby a single quantum of the light sets up a mechanism which effects the decomposition of a large number of molecules of the reacting substance. Similar chain mechanisms probably exist with X-rays and living tissue, the small initial effect being indicated by the fact that the erythema dose with X-rays involves the absorption of only about 0.003 calories per cubic centimeter of the surface tissue.

The rôle of the blood as a developing agent, acting in a manner analogous to a photographic developer, is suggested. In the photographic plate the primary action of light is to produce "centers," which are groups of atoms of silver in contact with silver halide. While the developer cannot start the reduction, it can carry on once it is started, because the reduction proceeds much more rapidly at the interface between the silver and the silver halide. Many other instances of chemical reactions occurring most readily at the boundary of two solid phases are known, *e.g.*, the reduction of copper oxide and the effect of deliberate addition of potassium chloride in accelerating the decomposition of potassium chlorate by heat. It is suggested that similar centers of decomposition may be produced in tissues by X- and γ-radiation, and that the blood acts as a developing agent. The small amount of energy required, the slow appearance of the reaction, and the effects of variation in blood supply accord with this view.

Radiosensitivity would, therefore, depend upon the number of centers initiated by the radiation and the suitability of the blood to carry forward the decomposition. Just as the number of centers produced in photographic film may be increased by use of sensitizers, such as dyes or allyl isothiocyanate, so sensitizers for living tissue probably exist. Search should be made for these along the lines of Reding and Slosse's work for means of altering the chemical composition of the blood in order to obtain the most favorable results.

A grain of silver halide can be completely reduced by the developing solution if it contains at least one center, and the probability of center formation in similar grains is governed entirely by the laws of chance. Thus an aggregate of silver halide granules would behave towards radiation in a similar way to an aggregate of living units, according to the work of Crowther, Packer, and others.

These views may be capable of application, although at present they rest upon a basis of imagined possibilities rather than of ascertained facts.

J. Gower Stephens, M.D.

THE CHEST (DIAGNOSIS)

The Distribution of Experimental Pulmonary Embolism in Roentgenograms. Ottavio Businco and Antonio Cardia. Fortschr. a. d. Geb. d. Röntgenstr., July, 1931, XLIV, 60-69.

The authors used for each experiment 8 c.c. of a 20 per cent suspension of bismuth in oil, which was injected either into the jugular or

the femoral veins of dogs. Roentgenograms were obtained at regular intervals of from 15 to 20 seconds, until the experimental animals died from asphyxiation within from 5 to 15 minutes.

The following conclusions are drawn: Peripherally injected embolizing material proceeds rapidly to the heart, and within from 20 to 30 seconds from the beginning of the injection it is found in the lungs. In the latter, it is found chiefly in the basal portions, usually filling first one lobe and then the other, so that within from 60 to 90 seconds, both lower lobes are completely injected. Usually the embolizing material fills the right lower lobe first. Gravitation, apparently, is of deciding influence for the localization of the embolism. The origin and location of the original embolic process is, in all probability, of importance for the localization in the lung. Direction, length, width, and distribution of the right pulmonary artery are partly responsible for the predominant localization of embolisms in the right lower lobe.

HANS A. JARRE, M.D.

The Bronchoscopic Treatment of Certain Pulmonary Diseases. Sam E. Roberts. Kansas City Southwest Clin. Soc. Monthly Bull., July, 1931, VII, 26-30.

The author discusses the indications and limitations of bronchoscopic treatment of pulmonary diseases. Contrary to popular opinion, the removal of foreign bodies from the air passages constitutes only a small percentage of conditions in which the bronchoscope has been found to be of value. The treatment, in skilled hands with trained assistants, is practically without danger.

Bronchoscopy is indicated in practically all suppurative lesions of the lung, all non-tuberculous obstructive lesions of the bronchi (and some of the tuberculous), and as a diagnostic procedure in questionable lesions.

The bronchoscopic treatment of asthma consists of dilatation by passing the bronchoscope and the aspiration of the thick tenacious secretions. Of especial value is the endobronchial examination by means of the bronchoscope, for, as Jackson has suggested, many of the symptoms of asthma may be present in patients who have not and never did have asthma. Willis Manges has demonstrated than in 157 asthmatic cases only 16 per cent were without evident tissue changes that could be demonstrated roentgenographically. In these roentgenologic studies, tuberculosis was found in 18 per cent of the cases, chronic lower-lobe infection in 23 per cent, and thickening of peribronchial and hilar shadows in 39 per cent.

The author is of the opinion that within a few years many cases of pneumonia will be successfully treated by bronchoscopic aspiration and irrigation. This is in agreement with the theory of Coryloss that "pneumococcic lobar pneumonia is a pneumococcic lobar atelectasis." The differential diagnosis between atelectasis and pneumonia is not easy, for the physical findings on chest examination are not sufficiently characteristic to differentiate the two conditions. The roentgenographic findings are quite positive, however. In atelectasis, the X-ray examination reveals retraction of the mediastinum to the affected side, decreased visibility, and elevation of the diaphragm of the involved chest.

J. N. ANÉ, M.D.

Spontaneous Bilateral Pneumothorax without Pulmonary Tuberculosis. H. M. Fine. Med. Bull. Veterans' Administration, August, 1931, VII, 769-771.

The author reports the case of a male, 40 years of age, who, at the time of admission, complained of frequent colds, dyspnea, loss of weight, and severe pains in the left chest. Physical examination of the chest revealed an absence of fremitus and breath sounds over the left side. Percussion showed a hyperresonance throughout this side. Roentgenograms showed the heart and mediastinum pushed to the right with an area of pneumothorax involving the entire left chest. The right lung revealed no evidence of tuberculous activity. Sputum tests were negative for acid-fast organisms.

On four different occasions it became necessary to remove air from the left chest. Ap-

proximately 48 hours prior to his death the patient began to grow rapidly worse, as indicated by cyanosis with rapid, shallow, and labored respiration, stimulants being ineffective.

Postmortem examination of the chest showed partial collapse of the right lung, no fluid being present. Hypostatic congestion was present in the middle and lower lobes, and the upper lobe was emphysematous. The left lung revealed complete collapse of both lobes. The left pleural cavity contained about 1,000 c.c. of a yellow fluid. There was no evidence of tuberculosis in either lung.

J. N. Ané, M.D.

Rare Types of Pleural Calcifications. A. Lippmann. Röntgenpraxis, Aug. 1, 1931, III, 680-684.

The roentgenologic diagnosis of large areas of calcification in the pleura is usually not difficult. Smaller circumscript areas can easily be confused with echinococcus, pneumoconiosis, tumors, or calcified tuberculosis. Fluoroscopy, with different angles, usually proves the pleural site of such calcifications, if thought of. The author describes three such cases in which the calcifications remained stationary for many years. Their clinical significance is small, as they indicate only a small localized harmless pleural scar.

H. W. Hefke, M.D.

The Limitation of Roentgenologic Demonstration of Pleural Exudates. E. E. Bauke. Med. Klinik, July 10, 1931, XXVII, 1032, 1033.

Even small amounts of fluid in the pleural cavity can be shown by roentgenologic means, when it accumulates in the lowest point, by reason of hydrostatic pressure. The clinical picture of a pleuritis exudativa lamellaris has recently been described, in which the exudate extends through the whole pleural cavity in a thin layer. Rasch and Fleischner have shown that in many of these cases a thin band-like shadow can be seen in the lateral portions of the chest. The author describes a case in which the roentgenologic examination was negative but the clinical findings and aspiration proved the presence of fluid.

H. W. Hefke, M.D.

THE CHEST (GENERAL)

A Case of Lung Abscess Caused by the Paratyphoid Bacillus. Alfred Thimm. Med. Klinik, July 17, 1931, XXVII, 1069.

The unusual occurrence of a lung abscess caused by paratyphoid bacilli, which were demonstrated repeatedly in sputum and aspirated material from the abscess, is described. Medical treatment led to restitution to the normal.

H. W. Hefke, M.D.

Tuberculous Atelectatic Cirrhosis of the Lung: Its Roentgenologic Significance. Karl Kornblum and Richard T. Ellison. Am. Jour. Roentgenol. and Rad. Ther., May, 1931, XXV, 620-628.

The authors call attention to an occasionally occurring, localized, well-marked density seen in the chest, which may be more suggestive of neoplasm than tuberculous disease, yet the process is actually a terminal stage tuberculosis in the nature of an old atelectatic cirrhosis. In the absence of tuberculous disease elsewhere in the chest, one may fail to give proper consideration to the possibility of the lesion being of tuberculous origin; however, if the trachea is drawn toward the area of density and the hilus structures also drawn toward the lesion, one may reasonably suspect the lesion to be of inflammatory nature. However, the development of the lesion is usually quite slow, hence a compensatory emphysema of the unaffected parts of the same lung may prevent much mediastinal displacement. If the contracting lesion is in the lower lobe, the hilus structures will not be displaced downward, but the diaphragm will, of course, be drawn upward.

Since cirrhotic contraction and endobronchial obstruction may produce an indistinguishable picture roentgenologically, such cases often need bronchoscopic study for final diagnosis. Because of the insidiousness of tuberculosis, the individual may be ill for years and go through all stages to atelectatic cirrhosis before first consulting the physician and roentgenologist.

J. E. Habbe, M.D.

THE CHEST (THERAPY)

Optoquine in the Treatment of Purulent Pleurisy in the Nursing Baby. Namerto Acuña, Saúl Bettinotti, and Maria T. Vallino. Semana Méd., June 5, 1930, XXXVII, 1409-1412.

The authors present their findings on four cases treated by them, because they believe that new methods should be tried out, since the surgical treatment of this condition produces a very high mortality. They repeat the method suggested by Gralpa. Three of the cases were purulent pleurisy following pneumonia, and the fourth one following la grippe.

The authors introduce a needle into the affected part, draw out the pus, and wash the cavity with 5 per cent optoquine, leaving from 2 to 5 c.c. of 2 per cent. The same process is performed daily for about ten days and radiographs are taken during that period. All four cases showed an immediate improvement. It was noted that the optoquine rendered the pus fluid, and produced sterilization of it, and that at the end there was always found an aseptic, gelatinous, hemorrhagic exudate. The authors' conclusion is that many cases are cured and that those not cured are, at least, rendered much better operative risks.

N. G. Gonzalez, M.D.

CONTRAST MEDIA

Hepatosplenography: Roentgenologic Demonstration of the Parenchyma of the Spleen and Liver by a New Colloidal Contrast Medium—Thorotrast—Introduced Intravenously. Silvije Kadrnka. Fortschr. a. d. Geb. d. Röntgenstr., July, 1931, XLIV, 9-15.

The theoretical possibility of the roentgen demonstration of the liver and spleen has been apparent since the advent of cholecystography and especially since Oka and Radt introduced a colloidal contrast medium called "Tordiol" for this particular purpose.

The author has found a new contrast medium called "Thorotrast," which is protected from precipitation in organic liquid and is used in urology for pyelographic purposes.

Thorotrast is a 25 per cent thorium dioxydsol, containing 22 per cent of thorium metal. It is diluted ten times with 5 per cent glucose solution, then sterilized and administered intravenously on successive days in increasing doses at body temperature. The initial dose should not exceed 0.1 gram of thorotrast per kilo of body weight. This dose is increased daily by 0.1 or 0.05 gram per kilogram until on the average a total of 0.3 gram of thorotrast has been administered per kilogram of body weight. After such series of injections have been completed, a rather intense opacity may be obtained on roentgenograms, which is equivalent in the liver region to the opacity of the spinal column, and in the splenic area to that of the ribs. As long as only the margins of the liver and spleen are to be demonstrated, one-half or even one-third of the total dose recorded may be sufficient for the purpose.

The liver and spleen are examined roentgenographically in various projections as the case may require. The roentgenographic opacity of the liver and spleen is produced by retention of the electrically negative charged thorium particles in the reticulum cells of the spleen and the stellate (Kupffer) cells of the liver. Smaller amounts of the contrast medium are also deposited in the bone marrow, the lungs, and the adrenal glands, but the amount retained in these organs is insufficient to produce opaque shadows. It is stated that with the dose mentioned and during limited periods of time no anatomic changes in

cells could be determined on animal experimentation.

The author considers this method as indicated in diseases of the liver and spleen which entail circumscribed pathologic anatomic changes, for instance, tumors, echinococcus cysts, encapsulated abscesses, syphilitic gummas, etc. Such processes must be apparent as deficiencies in the contrasted organs. Disease processes which cause diffuse pathologic anatomic changes in the liver and spleen are apt to be regarded as contra-indications for this procedure.

The elimination of the injected thorotrast is as yet unknown. Shadows produced by the injection of this medium persist for many months. The radio-activity of the thorium is considered as negligible, due to the relatively small amount injected and the wide distribution of the salt over large surfaces.

(*Abstractor's Note.*—We are of the opinion that in spite of the statement of the author that this contrast medium is non-toxic and its radio-activity is negligible, caution with its use is strictly indicated.)

HANS A. JARRE, M.D.

Chemistry and Application of Campiodol (Iodized Rapeseed Oil) in Roentgenography. George W. Raiziss, Mark A. Glaser, and Le Roy W. Clemence. Jour. Lab. and Clin. Med., July, 1931, XVI, 943-948.

In their search for the most satisfactory iodized oil which could be used in roentgenography, the authors have prepared campiodol, which is iodized rapeseed oil, containing from 43 to 45 per cent iodine and combining the properties of an entirely inert substance with the ability to cast excellent shadows. It is soluble in chloroform, ether, benzine, and carbon bisulphide, and insoluble in water and alcohol. It can be diluted by rapeseed oil, olive oil, or ethyl esters of olive oil. Extensive laboratory and clinical researches are attributed to Frazier and Glaser (*Jour. Am. Med. Assn.*, 1928, XVI, 1609).

The authors further state that campiodol has been successfully used in neurologic visualization in the diagnosis of various sinus infections, as well as in vascular, pulmonary, and genito-urinary visualization. As much as 5 c.c. of the oil have been used for visualization of cranial and peripheral vessels without any undesirable symptoms.

A. O. HAMPTON, M.D.

Visualization of Joints by the Injection of Iodipin. W. Knoll and Th. Matthies. Fortschr. a. d. Geb. d. Röntgenstr., January, 1931, XLIII, 85.

This is a demonstration of an ankle, a knee, and an elbow joint, partially and completely injected with iodipin. Experimentations on cadavers are reported. At present no application has been made for clinical purposes.

H. A. JARRE, M.D.

Thorotrast—a New Contrast Medium for Radiography. Gross. Schweiz. med. Wchnschr., June 6, 1931, LXI, 549.

The new medium is a 25 per cent colloidal suspension of thorium oxide, slightly opalescent, odorless, and having the consistency of heavy oil. A homogeneous solution can be produced by dilution with normal saline up to 1:8. For cystography, a dilution of 1:4 to 1:8 is used; for pyelography 12 c.c. of thorotrast is diluted with from 8 to 10 c.c. of water. Absolutely no immediate or remote deleterious action is produced, even in the most severe inflammatory processes; in fact, there is apparently a definite antiseptic effect. Thorotrast can be injected into fistulous tracts, producing excellent visualization with no reaction.

H. C. OCHSNER, M.D.

Some Therapeutic Uses of Lipiodol. M. H. Wilkinson. Med. Bull. Veterans' Administration, August, 1931, VII, 756.

Lipiodol is of greater value as a therapeutic agent when used in the early stages of bronchiectasis than when it is administered in the far-advanced cases in which marked dilatation and sacculation have occurred. In the experience

of the author, it may be given once a week over a period not in excess of nine months in the early stages of bronchiectasis. The results in all cases have been an elimination of many of the distressing symptoms of the condition. The length of time treatments may be given depends entirely upon the individual patient, as indicated by roentgenograms made immediately after administration of the drug, and by clinical symptoms. However, treatments should never be given more often than once in a period of seven days. In the treatment of bronchial asthma by lipiodol, benefit is reported by the author in about 50 per cent of the cases.

J. N. Ané, M.D.

The Use of Uroselectan in Roentgenography of Obstructive Lesions in the Urologic Tract. Lionel A. Mahone. Med. Bull. Veterans' Administration, August, 1931, VII, 726-731.

Dilatation in the urologic system occurs as a result of persistent mechanical obstruction or following prolonged infection. Either of these factors may act independently or in combination to produce dilatation in any given case. The value and importance of obtaining accurate knowledge of the changes in function, form, and position of diseased urinary structures can not be overemphasized, since it enables the urologist to plan intelligently a rational curative program of treatment. Ureteropyelography and cystography have proven their value in this regard. Intravenous uroselectan likewise has served as a valuable contribution in the diagnosis of obstructive lesions of the urologic tract. Uroselectan is especially useful in the large group of cases in which cystoscopy is impossible.

Uroselectan is a non-toxic, non-irritating, stable salt containing 42 per cent of iodine in an iodine-pyridin combination. It may be given safely to infants or the aged, and there is no contra-indication to its use in acute febrile conditions.

The author has used intravenous uroselectan in 15 ex-service men, whose ages ranged from 32 to 47 years. Of this number, 13 had long-standing urethral obstruction from stricture. Changes in form, structure, and function were demonstrated in all cases in which the lower urinary obstruction had persisted for a period of five years or more.

In all cases a roentgenogram was made immediately before the injection of the opaque medium. The warmed sterile 40 per cent solution of uroselectan was then divided in half, and, using Luer syringes, 50 c.c. were slowly injected into each cubital vein. From 12 to 15 minutes were required for the injection. The first exposure was made five minutes after the beginning of the intravenous administration while the injection was in progress. A series of seven or eight roentgenograms constituted the author's routine procedure.

A case is reported by the author in which the patient presented a history of much discomfort and suffering from multiple obstructive lesions of the urinary system. His illness began in 1917, with an acute gonorrheal urethritis. Roentgenograms after the intravenous administration of uroselectan revealed moderate hydronephrosis and a kink in the left ureter. This was confirmed by cystoscopy and uretero-pyelograms, which demonstrated also a urethral stricture and prostatic stones.

J. N. Ané, M.D.

DENTAL ROENTGENOLOGY

Apical Infection of the Teeth. Editorial, Can. Med. Assn. Jour., July, 1931, XXV, 81, 82.

Referring to the significance of the small areas of rarefaction that are often seen about the apices of teeth in the dental film, the editors quote from the January, 1931, issue of the *British Dental Journal* the results of some original work done by Arthur Bulleid. Mr. Bulleid examined eighty teeth which showed granulomas on the radiographs, and were extracted. Taking great care in his technic to avoid extraneous contamination, he made cul-

tures from the granulomas, both aërobically and anaërobically. From all the eighty cases, streptococci were isolated, usually alone, but sometimes with other organisms. Eight cases which gave no growth aërobically gave one under anaërobic conditions. This observer also brings out the interesting fact that granulomas are relatively common in pulpless teeth that have had their root canals filled.

L. J. CARTER, M.D.

DOSAGE

The Problem of Dosage in Dermatologic Roentgen Therapy. H. Fuhs and J. Konrad. Strahlentherapie, June 13, 1931, XLI, 101-113.

Based on the enormous amount of material of the two dermatologic clinics in Vienna, a recommendation for the roentgen treatment in skin diseases is given in tabular form by the authors. Individualization in dosage is stressed, as well as the advisability of applying the smallest doses required for a therapeutic result. For details, the interested reader is referred to the original.

ERNST A. POHLE, M.D., Ph.D.

Dosage with the Sabouraud-Noiré Tablet. Th. C. Neeff. Strahlentherapie, June 13, 1931, XLI, 114-123.

The author discusses common errors in the dosimetry with the Sabouraud-Noiré tablet and offers remedies for their avoidance.

ERNST A. POHLE, M.D., Ph.D.

The Protracted Fractional Method of Roentgen Therapy. A. Zuppinger. Am. Jour. Roentgenol. and Rad. Ther., June, 1931, XXV, 784-792.

Brief mention is made of each of the possible methods of roentgen irradiation of tumors as it is practised to-day, namely, the single large dose method, the "saturation method" of Pfahler (with which the writer has had no experience), the fractional method, and the continued radiation method.

The protracted fractional method of Coutard consists of daily small doses of low intensity for an interval of about three weeks until approximately six erythema doses have been administered to the skin. This method is recommended as superior to all other methods of irradiation of carcinomas of the tonsil, of the base of the tongue, of the hypopharynx and inner larynx, and has also been successfully applied to recurrent or metastatic tumors in other parts of the body. Skin and mucous membrane reactions usually occur, beginning about the twelfth to fifteenth day after treatment has been started. While appearing rather alarming when first seen, because of their superficial nature (to which the term "radio-epithelitis" has been given), they are usually rather completely cleared up within several months, with eventual restitution of hair growth and gland function. Tumors which do not completely regress are sometimes given supplementary treatment by electrocoagulation of the tumor rest.

J. E. HABBE, M.D.

Suggestions Concerning the Question of Dosage in Heliotherapy. W. Mörikofer. Strahlentherapie, May 20, 1931, XL, 682-689.

An analysis of a few factors involving the dosage of light shows the complex nature of the problem and demonstrates the necessity of close co-operation between clinician and meteorologist.

ERNST A. POHLE, M.D., Ph.D.

THE ESOPHAGUS (THERAPY)

Treatment of Carcinoma of the Esophagus. E. Musgrave Woodman. British Med. Jour., Aug. 15, 1931, No. 3,684, pp. 290-292.

Diathermy.—The proper use of diathermy, notwithstanding that it fails to cure, will, in the great majority of cases, maintain the patency of the lumen sufficiently for the patient to continue fluid nourishment.

External Radium Application.—This has not proved of much value in this area. It is remarkable how few cases of carcinoma of the esophagus within the region of the neck present themselves for examination and treatment.

Interstitial Application of Radon.—By this means, radium emanation is carried into the substance of the growth. The technic is as follows: The growth is treated by adrenalin before operation; the position of the lumen is ascertained, and if necessary it is dilated. The radon seeds are inserted by a special trocar and cannula, fitted on to a handle. They are buried deeply into the upper part of the growth, their number and position being checked by X-ray examination on the following day, at the end of a week, and at the end of a month. The disadvantage is that only the upper part of the growth can be dealt with at the first operation, leaving the lower part to be treated at a subsequent insertion. Experience is that the effect of the radon is to cause shrinkage and devascularization of the growth, and in two cases the growth has apparently disappeared entirely.

Central Application of Radium.—In this method the growth is dealt with from the center of the lumen, which is dilated, and a more or less rigid tube inserted, to the outer surface of which radium needles are fixed. It has the advantage of definitely dilating the lumen, and the disadvantage of dealing with the growth from the center and most degenerated part, which is farthest from the active and growing edge.

Gastrectomy.—From the endoscopical point of view, the author regards the necessity for this operation as an expression of complete failure.

W. Dundas Mackenzie, M.D.

EXPERIMENTAL STUDIES

On the Synergistic Action of Radium Chloride and Histamine. J. Marsalek. Compt. rend. Soc. de biol., Feb. 6, 1931, CVI, 332, 333.

The synergistic action of the two substances on the guinea-pig uterus is manifested only on adult animals. The rhythmic movements are increased and accelerated, and the tonus is also increased.

Henry Bayon, M.D.

Decrease in the Number of Mitotic Figures in Jensen's Sarcoma, Caused by X-rays. W. H. Love. Compt. rend. soc. de biol., July 16, 1931, CVII, 1042, 1043.

A group of rats having Jensen's sarcoma were treated with X-rays under specified conditions of dosage, etc. An equal number of rats similarly affected were used as controls. Two hours after treatment sections of the irradiated tumors were made, and counts showed a marked decrease in the mitotic index as compared to sections made of the controls (170 fields were counted in each tumor).

A curve is plotted to show that the maximum decrease in mitotic index occurs in doses up to 300 R-units (Solomon), after which much stronger doses cause only a slight further decrease.

John J. Archinard, M.D.

Comparative Study of the Quantity of Gas in the Bowel in Simple and Closed-loop Obstruction. H. G. Scott, H. J. Dvorak C. N. Borman, and O. H. Wangensteen. Proc. Soc. Exper. Biol. and Med., June, 1931, XXVIII, 902-904.

In previous studies the authors demonstrated that while the accumulation of gas (as detected by X-ray examination) is a reliable agent in the early diagnosis of simple obstruction, the roentgen evidence, in its early recognition, is not of the same value in strangulation obstructions.

In this study, thirty-six dogs were used and direct measurements of gas and fluid were made with a syringe and hollow needle in simple and closed-loop obstructions. The closed-loop, rather than strangulation obstructions.

were used for this comparative study, because dogs with closed-loop obstructions survive for longer periods. Late in the course of the obstruction, however, the closed-loop type assumes the features of a strangulation obstruction. The oral source of gas, which was believed by the authors to be an important factor in simple obstructions, was eliminated in the closed-loop type.

In seven of thirty-one dogs with closed-loop obstructions, no gas was found in the loops. The smallest amounts of gas and fluid observed in the simple obstructions were greater than any found in the thirty-one closed-loop obstructions. Gas accumulation in the closed loops was due largely to the activity of intestinal bacteria.

In another study, the authors established strangulation obstructions by tying off the mesenteric blood supply and the bowel wall at the proximal and distal ends of the obstructed segments. No gas was collected in any of the obstructed loops.

The authors believed that the exclusion of swallowed air from the closed and strangulated loops accounted largely for the significant differences observed in this study.

J. N. Ané, M.D.

The Effect of Roentgen Radiation upon the Reaction of the Fluid of Rat Sarcoma 10. L. C. Maxwell and H. J. Ullmann, with the Technical Assistance of Ella May Ottery. Am. Jour. Cancer, July, 1931, XV, 1401-1409.

Maxwell and Ullmann studied the chemical composition of tumor fluid of the Rat Sarcoma 10 following irradiation *in situ* with 90 K.V.P. unfiltered radiation of measured intensity.

They conclude that the tumor fluid of Rat Sarcoma 10 becomes more acid within twenty-four hours after irradiation of the tumor. This rise in acidity is due to an increase in the CO_2 tension of the tumor fluid. Little or no change in the $BHCO_3$, lactic acid, or other constituents of the tumor fluid was noted following irradiation.

John R. Carty, M.D.

Histologic Studies on Skin Irradiated with the Vitalux Lamp. Erich Uhlmann. Strahlentherapie, May 20, 1931, XL, 765-769.

Skin areas of 5×5 cm. size on the back of rabbits were exposed at 50 cm. distance to the rays of the Vitalux lamp. Biopsies were taken on the first, third, fifth, and seventh days after the exposure. It appeared that the histologic findings were similar to those described by Keller after exposure of the skin to the quartz mercury vapor lamp. The author concludes that this proves the presence of short ultraviolet rays in the spectrum of the Vitalux lamp to be of value in therapy. A few photomicrograms are appended.

Ernst A. Pohle, M.D., Ph.D.

THE FOOT

Notes on Foot Disorders among Natives of the Belgian Congo. Earl T. Engle and Dudley J. Morton. Jour. Bone and Joint Surg., April, 1931, XIII, 311-318.

The popular belief that most American and European foot disorders are caused by wearing improper shoes receives support in the findings of a New York expedition to Central Africa. Many unshod native feet were examined, and, though infected wounds and amputated toes were common, the so-called "static" foot troubles of civilization were absent.

Paul C. Hodges, M.D.

FOREIGN BODIES

Foreign Bodies in the Esophagus and Bronchi. Eeman. Bruxelles-Med., June 21, 1931, XI, 1017, 1018.

The author classifies foreign bodies of the esophagus as: (1) Deeply or slightly opaque, and (2) transparent, but more or less obstructive. Those of the bronchi are likewise classified, particularly as regards functional disturbances. Simple fluoroscopy or single antero-

posterior films are at times unreliable, views from various angles being often necessary. Frequently, single views reveal a very deceptive shadow in these cases. A true impression of the size, shape, and position of the object can be obtained only by comparison of films made from various angles. In the case of transparent objects in the esophagus, ingestion of opaque liquid may help. Careful esophagoscopy is often necessary.

The history, symptoms, and clinical signs are usually more important in the case of foreign bodies in the bronchi, which are very frequently transparent, *viz.:* organic matter.

Careful fluoroscopy and radiography of the lung fields and diaphragmatic movements are of the greatest help, at times being diagnostic.

Four types of lung pictures are noted:

(1) *Emphysema by Obstruction.*—This being a transitory phenomenon, it is best noted by the prolonged expiration, since increased transparency of lung tissue is often hard to discern. The location and extent of the emphysema depend on the location of the foreign body. The corresponding portion of the diaphragm is lowered and has impaired mobility; the mediastinum and heart are displaced to the side opposite the foreign body. "Rapid shots" taken at the end of inspiration and again at the end of expiration are suggested. Sometimes displacement of the cardiac shadow is striking. In low obstruction the heart moves like a pendulum. If the obstruction is high, the entire shadow is uniformly displaced. In tracheal obstruction there is a rotation, during expiration, so that the heart seems to stand on its apex. In these cases the diaphragm is lowered *in toto*. The intensity of the signs is sometimes affected by a change in the position of the foreign body.

(2) *Atelectasis or Pulmonary Collapse.*—When the foreign body causes total obstruction, a homogeneous shadow is noted, with displacement of the heart and mediastinum toward the affected side. In sudden atelectasis without apparent cause, the presence of a foreign body should be suspected. In certain of these cases, bronchoscopy alone will confirm the diagnosis.

(3) *Edematous Lung.*—The bronchi can often be distinguished.

(4) *Pulmonary Abscess Is a Late Result.*

For the roentgenograms, dorsal decubitus, with the arms placed beside the head, "rapid shots," one-thirtieth to one-tenth of a second, are suggested.

JOHN J. ARCHINARD, M.D.

GALL BLADDER (NORMAL AND PATHOLOGIC)

Two Cases of Double Gall Bladder: Clinical and Laboratory Notes. Canadian Med. Assn. Jour., June, 1931, XXIV, 849.

This is an abstract from the *Lancet*, 1931, I, 751, of an article by Paul Cave, in which he reports two cases of double gall bladder discovered by him, the first to be diagnosed by cholecystography in England.

Recognition is given of the reports of Climan, Meyer, Nichols, and Hayes, who have each reported one case. Graham did not find a single case among 1,218 cases examined by cholecystography, showing the rarity of the condition.

Boyden, in the *American Journal of Anatomy*, 1926, XXXVIII, 177, found that the incidence of double gall bladder in the human subject is one in three or four thousand, in a series of 19,000 examinations.

L. J. CARTER, M.D.

An Experimental Contribution to the Negative Cholecystographic Response in the Presence of Duodenal Ulcer. A. Leb. Fortschr. a. d. Geb. d. Röntgenstr., July, 1931, XLIV, 16-27.

In a group of patients with duodenal ulcer who were subjected to cholecystographic examination by the intravenous method, 26 per cent produced a negative response, while the gall bladder had to be considered organically normal. Out of 25 patients with duodenal ulcer and negative cholecystographic response

who came to operation, 40 per cent were found to have an entirely normal gall bladder. Practically all of the positive responses in the presence of duodenal ulcer revealed dyskinesias of the gall bladder in the form of either accelerated or retarded emptying mechanism. All these observations are considered as produced by nervous irritation of all intra-abdominal organs, due to the presence of the ulcer.

Animal experimentations lead to the conclusion that an adhesive periduodenitis involving the duodenum and gall-bladder region produces marked prolongation of the emptying time of the gall bladder. Such processes lead to a stasis in the gall bladder and a blocking of the cholekinetic stimulus normally produced in the gall bladder by passage of food through the duodenum.

On experimentation with dissected specimens of the biliary passages, it was found that in the presence of stasis in the gall bladder it is very difficult to introduce additional opaque bile, while a ready filling of every empty gall bladder could be accomplished.

(*Abstractor's Note.*—These latter experiments, we believe, should be regarded as entirely unphysiologic though conclusions do not appear illogical. The value of this paper is to be seen in the demonstration of the close interrelationship of the abdominal organs and the emphasis laid upon the idea that disturbance of one abdominal organ might readily produce dysfunction of distant organs by a reflex phenomenon.)

HANS A. JARRE, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Polyposis of the Colon in Children. Roger L. J. Kennedy and Harry M. Weber. Am. Jour. Dis. Child., July, 1931, XLII, 69-76.

The present opinion seems to be that single polyps or polyps that occur in small numbers are of relatively common occurrence and differ from those making up the picture of generalized disseminated polyposis, which occurs with relative rarity.

Two cases of diffuse polyposis that had not undergone malignant change, and a third case of polyposis that was not diffuse but which showed a low grade adenocarcinoma implanted on an adenoma, are reported. They occurred in children ranging from two and one-half to ten years of age.

Roentgenograms made after the application of the Fischer double contrast technic (barium mixture and air) demonstrated small, rounded shadows and characteristic lacy network of shadows said to be pathognomonic of the disease.

The early age of onset suggests that the lesions are congenital. There is a familial tendency and the lesions tend to undergo malignant change early. The outstanding symptom is a profuse bloody diarrhea. Digital examination of the rectum, together with proctoscopic, roentgenographic, and roentgenoscopic examinations should be made to establish a diagnosis.

F. B. MANDEVILLE, M.D.

Study of the Motility of the Stomach. J. Nebout. Jour. de Radiol. et d'Électrol., May, 1931, XV, 225-237.

"The dyspepsias are chemical or not," said Germain Sée. A large amount of study has been given to the chemistry of the gastric juice in cases of dyspepsia, but very little study has been given to the motility of the stomach.

The author describes the "polygraphic plates." In this method, after immobilizing the patient and having him hold his breath, a roentgenogram is made, using one-third the usual normal exposure. After from 3 to 5 seconds and without the patient moving or breathing, a second exposure is taken, again at one-third of the normal. After an interval of from 3 to 5 seconds under the same conditions, a third exposure is made with the same technic. This gives a normal exposure of the stomach, but, due to the peristaltic waves, the edges show light shadows of different intensity, which gives an idea of the peristaltic waves.

The author describes the tonicity and motility of the normal stomach and also of the abnormal. Normal motility is characterized by:

(1) The position of the contractions; (2) the amplitude of each contraction; (3) the frequency and rhythm of the contractions, and (4) the regular movements of the contractions.

The normal emptying of the stomach depends upon the discharge through the pylorus and the intensity of the peristalsis. The classical explanation of the opening and closing of the pylorus, dependent upon the changes in the reaction of the stomach and intestinal contents, is denied by the author.

Experimenting with 40 c.c. 2 per cent HCl in the gastric cavity and 2 per cent, 5 per cent, and 10 per cent HCl in the duodenum by means of the duodenal tube or by the introduction of alkalies in the first portion of the duodenum had no action on the pylorus.

The author believes that the opening and closing of the pylorus is due to the mechanical action of the peristaltic waves of the stomach passing over it. He describes the pathologic motility of the stomach, hyper- and hypoperistalsis, reverse peristalsis, spasms, segmentary rigidity, and extensive infiltration of the gastric wall.

LESTER J. WILLIAMS, M.D.

Independent Occurrence of Ulcer and Cancer of the Stomach. H. L. Bockus and J. Bank. Med. Clinics N. Am., January, 1931, XIV, 869-884.

The authors describe two quite similar cases of gastric ulcer in the body of the stomach, both being primarily diagnosed peptic ulcer. The presence of a high-grade retention being unusual in their experience in corporic gastric ulcer, a second lesion was suspected at the pylorus. Duodenal ulcer seemed to be most likely because of the roentgenologic study and hyperacidity. A review of the films in the two cases suggested the existence of a smooth infiltrating lesion in the pre-pyloric region, although the radiographer made no mention of this. A definite pre-operative diagnosis of cancer at the pylorus was not made in any case, although the retention was considered to be due to a lesion in that region and not to the gastric ulcer.

The niche of a benign gastric ulcer often disappears roentgenologically within two to three weeks after the institution of medical treatment. If it has not been diminished considerably in size at the end of three weeks, an ulcerating carcinoma must be seriously considered and a laparectomy advised.

These authors emphatically state that a great deal of misinformation has existed relative to the relation between gastric ulcer and cancer. It has been believed by some that gastric ulcer frequently becomes malignant. We now know that this is not so. Their experience has been identical with that of R. Brown, who found that cancer developing in a stomach possessed of an ulcer is usually in a part of that organ distant from the ulcer.

D. N. SILVERMAN, M.D.

Demonstration of the Gastric Relief in the Recumbent Position. E. Hayer. Fortschr. a. d. Geb. d. Röntgenstr., July, 1931, XLIV, 70-77.

Beyond demonstrating that a satisfactory film of the relief of the gastric mucosa may be obtained with the patient in the recumbent position, this article furnishes no important new information not to be found in the extensive publications of Forssell, Berg, Dyes, and others.

HANS A. JARRE, M.D.

Roentgenologic Diagnosis of Varices of the Esophagus and Stomach, and the Importance of this Diagnosis for Clinical Study. R. Schatzki. Fortschr. a. d. Geb. d. Röntgenstr., July, 1931, XLIV, 28-39.

To demonstrate the presence of varices in the esophagus and stomach, one has to use a barium suspension of such consistency that a tenacious coating of these organs may be obtained. The following symptomatology of esophageal varices is given: Destruction of the normal esophageal linear relief; observation of tortuous, occasionally branching, bands and also of rounded areas of increased translucency which, with complete filling, are occasionally seen as border-forming marginal

filling deficiencies. In their presence, the emptying and cleaning mechanism of the esophagus is delayed, and a residual coating demonstrating these conditions persists for an appreciable time.

Such changes must be constant. To differentiate them from malignancies, one must observe normal pliability and distention of the esophagus. Varicosities in the proximal portions of the stomach or fundus may produce very similar or identical pictures.

Five cases of esophageal varices and two with gastric varicosities are reported. This diagnosis, of course, must be of importance for therapy and prognosis of patients afflicted, as not infrequently the suspected clinical diagnosis is ulcer or malignancy.

HANS A. JARRE, M.D.

The Fate of Patients with Carcinoma of the Stomach, Seen in the First Medical Clinic. Karl Hitzenberger and Deszö Merkler. Wien. klin. Wchnschr., May 15, 1931, XLIV, 632-634.

During the last ten years, 272 patients with carcinoma of the stomach have been seen. A follow-up examination showed that 178 were inoperable on admission, 94 were referred to the surgical department, 70 died soon after operation, 9 of the 94 seem to have been benefited somewhat by surgery, and 9 are still alive and without recurrence from 1 to 10 years after operation. An "early diagnosis" was made in only about 2 per cent of the cases admitted. Only 2 out of 100 cases seen by the internist have a chance for cure by surgery.

H. W. HEFKE, M.D.

Intestinal Obstruction. Fred M. Drennan, Frank C. Val Dez, and John C. Murray. Med. Clinics N. Am., March, 1931, pp. 1083-1096.

The authors report five interesting cases of intestinal obstruction illustrated by roentgenoscopic studies. In Case 1, the X-ray examination was made by use of the barium enema, because the history and findings were those of bowel pathology and in such cases it is unwise to give an opaque meal by mouth and run the risk of not being able to get it through an obstructed portion of the gut. It was noted at the beginning of the fluoroscopic examination that there was a considerable amount of gas distention in the gut. The enema filled the rectal ampulla and descending colon normally, but met with a definite obstruction at the splenic flexure of the transverse colon, causing the patient pain and finally passing through a canalized irregular area, as illustrated.

In Case 5, the X-ray film revealed a distended gas pocket along the course of the descending colon, extending well down to the pelvis. Fluoroscopic examination by means of the barium enema was then made, and it was found that the colon, filled to normal size, was lying lateral and anterior to the gas pocket described, moving the supposed obstructing pathology to above the large intestine. At operation it was found that the patient had a perforating ulcer on the lesser curvature of the stomach anteriorly, which would fit with his severe attack of pain. The stomach, peritoneum, transverse and descending colon had formed a pouch extending, not into the lesser peritoneal cavity as is usual, but medial to the descending colon and down to the pelvis, an extension which is believed quite rare, justifying a report of the case.

D. N. SILVERMAN, M.D.

The Significance of Roentgen Investigation in the Diagnosis of Ileus in Childhood. G. Weber. Monatschr. f. Kinderheilk., 1930, XLVII, 11-23. Abstracted in Zentralbl. f. d. ges. Radiol., Sept. 19, 1930, IX, 275.

Schwarz' finding, the roentgen demonstration of a fluid level in the gas-filled loop of bowel above a bowel obstruction, is, the author believes, too little known. This positive roentgen finding, which can be quickly demonstrated without administration of a contrast medium, is of great significance as an indication for operation, especially when there is widespread extension. This method gives little

information on the type and site of obstruction. For this purpose, it can be supplemented by the oral or rectal administration of a contrast medium. Negative findings by the latter method permit the exclusion of a complete bowel obstruction. Isolated fluid levels are often found in the large bowel of normal individuals and occasionally in the small bowel in spastic conditions.

H. C. OCHSNER, M.D.

Duodenitis: Review of Twenty-six Cases So Diagnosed. T. Grier Miller. Med. Clinics N. Am., January, 1931, XIV (Philadelphia Number), 841-853.

The more important data in this study are charted and because of their significance as diagnostic criteria, the roentgenologic observations are placed first. The author takes up a description of the type of stomach by stating that this organ was normal or fish-hook in 20 of the 26 cases, of the steer-horn type in three, and of the ptotic type in three. This indicates that in all but three the greater curvature was at or above the level of the iliac crests. This observation would seem to rule out gastric ptosis as an important factor in the etiology.

Six hours after a barium meal gastric residue was present in but three of the cases, and in two of these it was very slight. This is in agreement with Kirklin's statement and is distinctly different from the observations reported in cases of ordinary duodenal ulcer. In his own duodenal ulcer cases, the author found a residue in 60 per cent, and in gastric ulcer it was 72 per cent, this being the usual experience. Its absence in duodenitis, in spite of pylorospasm, will be referred to later.

The peristalsis and motility observations are quite similar to those of duodenal ulcer, as might be expected, since in both lesions there exists irritation of the pyloroduodenal region, without, in most instances, organic stenosis. Peristalsis was above normal in 75 per cent; motility, in 50 per cent. His corresponding figures for ulcer were 65 and 51 per cent. Pylorospasm occurs more often in duodenal ulcer than is sometimes suspected and often leads to the erroneous diagnosis of pyloric ulcer. It may be due, in such duodenal ulcer cases, to an associated pyloro-duodenitis. In the author's cases of duodenal ulcer, he found pylorospasm in 36 per cent; in his duodenitis cases it occurred in 42 per cent (11 cases). It is interesting that in spite of the spasm, six-hour retention was very rare in the duodenitis cases. This suggests that the spasm is less persistent in duodenitis.

Duodenal cup irregularity was demonstrable in the film of every case in which the cup retained enough barium to be visible. Sometimes it was observed under the fluoroscope, when the films did not show the cup. This irregularity differed, however, from that of ulcer in that it was never constant. On this point of inconstant irregularity above, ulcer can usually be eliminated. This observation is a very significant one in favor of the diagnosis of duodenitis, and one that has been emphasized by all of the roentgenologists. The roentgenologic characteristics of duodenitis seem to be irritability, non-retentiveness, and inconstant irregularity, this group of phenomena being uncommon in either ulcer or adhesions.

D. N. SILVERMAN, M.D.

Megacolon. Angel Dagnino. Semana Méd., Dec. 18, 1930, XXXVII, 1891-1919.

In this article, the author presents eighteen cases of this condition and goes into detail concerning each one, presenting radiographs to confirm his diagnosis. He concludes that such a condition can be congenital or acquired, that it possesses a typical symptomatology, that X-ray is not essential for the diagnosis, and that treatment improves its symptoms.

N. G. GONZALEZ, M.D.

The Roentgenologic Demonstration of Polypoid Lesions and Polyposis of the Large Intestine. Harry M. Weber. Am. Jour. Roentgenol. and Rad. Ther., May, 1931, XXV, 577-589.

Polypoid lesions of the colon, unlike most other organic diseases of this part of the

gastro-intestinal tract, can not often be well demonstrated by the ordinary opaque enema method unless they be unusually large. The sites of preference for this group of tumors are the rectum and distal segments of the colon, the essentially benign types, however, not showing this preference of location. Polyposis, so often associated with chronic ulcerative colitis, is often of very diffuse involvement, but the polyps will often be entirely obscured by the usual opaque enema method of study. In cases in which such a type of lesion is clinically suspected, or when there is clinical evidence of intestinal bleeding and the ordinary method of study has yielded insufficient precise information, the author proceeds with the "combined method," air being injected into the colon immediately after as complete evacuation as possible of the opaque enema. After distention of the entire colon, stereoscopic radiographic study, with the patient lying on the abdomen, is made.

The author does not apply the method routinely but has in selected cases obtained gratifying results by showing single or multiple polypoid lesions not recognizable by the ordinary enema procedure. Tumors of less than one centimeter in diameter may escape detection even with an entirely satisfactory double contrast study having been obtained.

It is suggested that with increase in skill and experience with the method, it might be worth while to apply it in the presence of any organic lesion of the colon for the additional diagnostic data it might afford.

J. E. Habbe, M.D.

GASTRO-INTESTINAL TRACT (THERAPY)

A Simplified Procedure for the Introduction of a Tube into the Duodenum. Morton Morgenstern. Jour. Am. Med. Assn., July 18, 1931, XCVII, 175, 176.

The tube passed into the stomach is manipulated by fluoroscopic assistance in a manner diagrammatically outlined. Guided toward the pyloric canal by the operator's right hand, the tube is gradually massaged into the first portion of the duodenum and introduced approximately from 1 to 2 inches past the spinal column. It is held in this position while the patient swallows more of the tube. The patient's hand is then substituted for the operator's hand to keep the greater curvature in a level with the pylorus. The patient is laid on the right side and aspiration is started.

In approximately fifty cases, the performance of this procedure has saved from one and a half to two hours for complete biliary drainage.

C. G. Sutherland, M.B.(Tor.)

Congenital Pyloric Obstruction: Recent Observations. Orville Barbour. Jour. Am. Med. Assn., Aug. 15, 1931, XCVII, 455-460.

Most authorities agree that there is some gastric and pyloric muscular spasm in every clinical case of pyloric stenosis. The majority of writers attribute the disorder to an imbalance of the involuntary nervous system. The symptoms in pyloric stenosis might occur as a result of suprarenal impairment. The resultant vegetative imbalance could produce the various degrees of pylorospasm and hyperperistalsis.

Persistent projectile vomiting, visible gastric peristalsis, and spastic constipation in newborn infants are indicative of pyloric obstruction. With the internal methods of treatment the diet has received a great deal of attention. Thick food, especially thick cereal, is now used almost universally. Atropine has found favor among the majority of clinicians. Phenobarbital and Vitamin B are recommended.

Several observers have reported satisfactory results with irradiation. In the author's experience, the saving of time and the lesser probability of injury to the patient make roentgenotherapy worthy of consideration. By the application of from three to five minutes of the roentgen rays, one may ascertain within twenty-four hours whether or not an operation will be necessary. Should more than one treatment be required, the effects of radium are more lasting than those of roentgen rays.

In surgical treatment the Rammstedt operation is the method of choice.

C. G. SUTHERLAND, M.B.(Tor.)

Diet in Intestinal Disorders. J. Arnold Bargen and Sister M. Victor. Jour. Am. Med. Assn., July 18, 1931, XCVII, 151-153.

The principal function of a major portion of the large intestine is storage. Some absorption takes place in the right half of the colon; however, most of the digestion and absorption occurs in that part of the gastro-intestinal tract which is above the colon.

Many internal abdominal disturbances in which there were no demonstrable inflammation of the large intestine have been called colitis. Helpful suggestions are outlined relative to diet for certain chemic ailments which afflict the intestine of man, such as chronic ulcerative colitis, diverticulosis and mild diverticulitis, malignant disease in its pre-operative phase and in certain post-operative complications. A diet is included for patients who have undergone colostomy.

Realizing that much harm has been done by fads and fancies resulting in ill-advised or wrong conceptions of the necessities, an attempt, based on wide experience, has been made to outline a rational scheme of diet.

C. G. SUTHERLAND, M.B.(Tor.)

GENITO-URINARY TRACT (DIAGNOSIS)

Uroselectan "B": An Extra-ureteric Shadow as a Cause of Renal Pain. Frank Kidd. British Jour. Urol., June, 1931, III, 179, 180.

A case simulating renal colic is reported, which, on urographic examination with uroselectan "B," demonstrated a negative urinary tract on the right side and a slight constriction at the left uretero-pelvic junction. Several extrarenal shadows were present. The possibility of calcified lymph glands, with adhesions attached to the uretero-pelvic junction producing constriction and colic, was considered.

DAVIS H. PARDOLL, M.D.

Principles and New Advances in Excretion Urography. Alexander von Lichtenberg. British Jour. Urol., June, 1931, III, 119-165.

This report deals with the results of over 2,000 clinical cases and with the investigation of seven different substances for intravenous urography. The new method, in addition to detecting anatomic changes, serves to reveal the pathologic condition in all its physiologic details, that is, a picture of the kidney function and of the dynamics of the urinary tract. A correct investigation and application of the principles of excretion urography will result in a new viewpoint of the pathology and therapy of the urinary tract.

This author states that the observations of others are unsatisfactory if they claim that they have observed the failure of normal kidneys to excrete the contrast substance. He further asserts that this condition is impossible. Normally functioning kidneys, with normal or hypertonic motility of the urinary tract, are least suitable for roentgenologic examination. If the exposure is taken during systole, visualization will be lacking. In those cases in which the emptying of the upper urinary tract is accelerated or precipitous, repeated exposures may also be ineffectual. One might obtain visualization of only single calices or small portions of the ureter which might not be recognized by those who have not had much experience.

This method is suitable as a clinical index of kidney function, the excretion substance being eliminated by a normally functioning kidney in a measure of its relative or absolute threshold. Since Hughes and Peterfi found that the uroselectan group is eliminated, principally through the glomerulus, this method has served as a detector of glomerular damage. Tubular disease, alone, over-estimates the functional state of the kidneys by the degree

of visualization obtained, based on the above fact. This is obviously due to the retention and the enrichment of the contrast substance in the urinary tract. This test of kidney function is an estimate of the momentary state and is by no means a measure of permanent damage. One has to ascertain the cause of the obstruction to kidney function. It may be a stone in the ureter, cavernous and toxic renal tuberculosis, or an infected stone kidney, or acute pyelonephritis. The degree of kidney function may be estimated by the time of appearance of the shadows and by the intensity of the visualization.

The extent of renal function, if the above mentioned principles are adhered to, may readily be determined if unilateral impairment is present. On the other hand, if the condition is bilateral, satisfactory interpretation is not so easily concluded. Visualization is negative in pronounced renal insufficiency. If peripheral obstruction is present, one may obtain a visual functional test even in pronounced kidney decompensation. Blood chemistry should be resorted to in order that the true condition of the renal parenchyma may be determined or an estimation of the uroselectan in the blood made (method of Heckenbach, Tourné, and Damm).

In unilateral kidney disease, excretion urography not only demonstrates the side on which the pathology is located but also the extent of functional disturbance. The anatomical diagnosis is also made possible. If no visualization is obtained because of renal damage, instrumental pyelography must be resorted to for anatomical diagnosis. The indication for radical or conservative surgery rests on the anatomical facts.

In bilateral kidney disease, excretion urography tells us the degree of kidney damage. In cases in which this condition is secondary, due to peripheral causes, this method offers us all the information we desire. In bilateral primary renal disease, however, this procedure is valueless for estimation of function, but does aid in the anatomical diagnosis and in the operative indications.

Excretion urography is important in detecting disturbances of kidney function and urine transportation. The viewpoint of organ-to-system pathology has been altered by this method. Disturbances of the urinary tract and kidney disease in their relation to each other may be diagnosed by this method and treated accordingly.

The author claims compression inhibits the dynamics of the urinary tract, and shadows which resemble peripheral obstruction are obtained by this method. This means, even taking into consideration that it often prevents true interpretation of urinary physiology, is not of much value. It is definitely contra-indicated in diseases of the lower one-third of the ureter, for it confuses the estimation of the degree of obstruction. In hypertonicity and early cases of tuberculosis and tumor, it may be employed, but it is of doubtful service.

The capacity and form of the pelvis are not important, but rather the ability of fractional and of periodic complete emptying. Instrumental pyelography never visualizes the normal pelvis; it is either over-distended or contracted, due to reflex irritation of the walls.

With excretion urography we learn that the pelvis does not have a constant size or form, but is constantly changing, due to peristalsis. Whether the filling is greater than the emptying is an index of evaluating dynamic disturbances and is one of the chief purposes of this method. Also, nephrography itself is made possible, depending upon the amount of functioning parenchyma and the presence of the contrast substance.

A good kidney shadow and a poor urogram may be explained by delay in elimination and retention of the substance in the kidney. By its presence or absence in the kidney we are as yet unprepared to estimate function or nonfunction of the tissue. Localization is impossible by this method in nephrograms, which may be explained by increased density of the pathologic processes themselves. Excretion urography applies physiologic factors to diagnosis and uses kidney functions to act as their own interpretation.

The biologic factors which lead to the selection of a useful compound will be considered. The first prerequisite is tolerability. Tabulation I demonstrates the very great tolerability

of the new substances. One must consider not only immediate reactions but also the elimination of the substance in pathologic cases. This results in definite contra-indications, and selection of the proper compound for individual use may be suggested. Tabulation II shows from 56.27 to 86.5 per cent eliminated in the urine, depending upon the substance employed.

The use of these substances is contra-indicated in badly altered kidneys because of retention. Also, poor visualization does not warrant their use in these cases. In these conditions the liver vicariously takes over this function of elimination. A combination of liver and kidney disease, therefore forms the second contra-indication of these substances.

Tabulation III shows the reactions which follow intravenous injection. D 40 is best tolerated and causes only local reactions, such as vein cramp, etc.

Tabulation IV shows the possibility of injecting smaller amounts of the new substances.

All intravenous substances are suitable for instrumental pyelography because of their high molecular weight, non-irritating properties, and non-toxicity.

We can measure the kidney capacity for contrast substances by determining (1) the absolute quantity of substance excreted; (2) the acceleration and time interval of elimination, and (3) the time in which the greatest percentual concentration of the substance in a definite quantity of urine is reached, and the absolute height of this concentration.

It is important that the quantity eliminated through the kidneys shall appear in the urine as quickly and in as concentrated a form as possible. The accompanying diuresis plays an important rôle, for it influences the concentration of the substance in the urine.

Tabulation V shows that all five new substances reach their highest concentration in the urine in from one-fourth to one-half hour after the injection. Abrodil and uroselectan require from three-fourths to one and one-fourth hour.

Tabulation VI shows the quantity of each substance required for injection.

Tabulation VII demonstrates that the usefulness of a substance for excretion urography is not only dependent upon the absolute kidney capacity but on the concentration in the urine. Some substances, for example, uroselectan, require less concentrating kidney function and are more useful in cases of tubular disease for this very reason.

Tabulation VIII shows that the kidney capacity does not depend entirely on physical factors. The chemical composition (molecular weight) of the substance seems to play a part.

Tabulation IX shows the graphic formulæ of the substances. The velocity and uniform ability of elimination are important factors. Also the degree of solubility influences the applicability.

Tabulation X shows that the iodine content is not the all-important factor for visualization. The physiologic factors are more important than the chemico-physical.

Tabulation XI stresses the value of D 40.

Tabulation XII demonstrates that the iodine content does not play the important rôle it was supposed to do. Most of the new substances, in spite of much lower dosage, are eliminated quicker and in greater concentration. The physiologic postulates are better filled by the new substances. It means selection of the proper contrast substance for each individual renal requirement. Solubility is important, permitting the injection of large amounts in a small quantity of fluid.

Tabulation XIII compares the solubility, iodine content, molecular weight, dosage, amount of iodine injected in single cases, the diuresis, and the specific gravity of the urine. The new substances have distinct advantage.

Tabulation XIV shows the amount of substance eliminated, the time interval, and the average amount of substance in 1 c.c. of urine in the first two hours.

Tabulation XV demonstrates the type of elimination, the constancy and velocity.

The elimination of the substance through the kidney plays the dominant rôle, not the iodine content, although good solubility and high iodine content are relatively important. The physiologic outweigh the chemical and physical factors.

The absolute roentgen intensity is under in-

vestigation to determine whether it is due to molecular weight or chemical structure.

Twenty-four illustrations are presented of the various lesions of the genito-urinary tract. The old and the new substances in excretion urography are compared with instrumental pyelography.

The paper is a very comprehensive, complete, and interesting report on excretion urography and should be referred to by all interested in this branch of medicine. The picture is presented from all viewpoints and serves to demonstrate the possibilities of excretion urography.

DAVIS H. PARDOLL, M.D.

Cystogram of Carbuncle of Bladder. Frank Kidd. British Jour. Urol., June, 1931, III, 178, 179.

A cystogram of an abscess communicating with the bladder is reproduced. This carbuncular abscess appears to empty into the bladder by several openings and followed the rupture of a prostatic abscess.

DAVIS H. PARDOLL, M.D.

A Few Practical Precepts in Urology. Eugène Tant. Bruxelles Méd., July 19, 1931, XI, 1113-1120.

The author in this excellent article reviews certain axioms or fundamentals always to be remembered in the treatment of urologic cases. Among other things, he makes a strong plea for the more frequent use of the X-ray in diagnosis. He cites several examples, typical of hundreds of cases, in which severe and often fatal consequences result from the failure to appreciate that apparently mild urinary disturbances often have a serious background. Many of these oversights could be avoided by taking X-ray films. Every patient having a urinary disturbance in which, after usual diagnostic methods, no improvement follows, and no definite cause can be established, should have an X-ray of the entire genito-urinary tract made. If this does not reveal the cause, cystoscopy should be performed, supplemented, if necessary, by the X-ray.

Large stones lodged in the kidney may exist and slowly destroy the organ, giving very little warning of their presence. Stress is laid particularly on X-ray examination of the entire urinary tract and not a portion of it, the reason being that infection, stone, or other disorder in one portion of the tract often gives symptoms referred to another portion of it. Among other conditions which are deceptive clinically, but which the X-ray, associated with cystoscopy, demonstrates very well, are (besides renal calculus) diverticula of the bladder, ptosis of the kidney, prostatic stone, and various tumors of the kidney and bladder. Hematuria, when the cause is not obvious, is always an indication for X-ray examination and cystoscopy.

JOHN J. ARCHINARD, M.D.

Physiologic Data upon Renal and Ureteral Function as Recorded by the Jarre Cinex Camera. Robert E. Cumming. Jour. Urol., June, 1931, XXV, 613-623.

The Cinex Camera with its film band allows many exposures, regularly timed as desired, and furnishes a permanent record of the patient's renal and ureteral activity. Physiologic data upon the transport or emptying mechanism are readily obtained by means of this apparatus. Its use is inexpensive and entirely safe from the standpoint of exposure to roentgen rays.

Concerning intravenous urography, the author found pyelognost to fulfill the requirements as to furnishing a proper contrast medium, but the severity of the reactions it causes necessitates cautious use. Uroselectan, while safe for intravenous use, is excreted and evacuated too rapidly to permit good visualization of the entire kidney pelvis and ureter simultaneously in normally functioning kidneys. The best visualizations were obtained in cases with some degree of ureteral obstruction and in cases with delayed evacuation time. Hydronephrosis renders excellent visualization.

Valuable information concerning the excretory function can be determined by a study of bladder visualization, by recovery of the substance from the urine, and by a study of the specific gravity of the urine during the time of excretion. The greatest concentration of uroselectan in the kidney occurs, in most cases, during the second hour following the injection.

Patients convalescing from kidney operations may be subjected to intravenous urography without ill effects. Following nephrectomy, concentration in the remaining (normal) kidney is good, and dense pyelograms are obtained.

Intravenous urography in combination with the use of the Cinex Camera constitutes a very definite advance in urologic diagnosis.

DAVIS H. PARDOLL, M.D.

Intravenous Urography. N. E. Berry. Canadian Med. Assn. Jour., June, 1931, XXIV, 798-803.

This paper is a critical review of 50 cases, in which uroselectan was employed intravenously in the Department of Urology of the Royal Victoria Hospital, Montreal.

The author cautions against the over-enthusiastic, non-critical attitude assumed by many users of this method, which is of recent origin and with which there is as yet limited experience. Reports of brilliant results are everywhere met with; failures are rarely mentioned, and the day is foreseen "when catheterization of the ureter will probably become as obsolete as laryngeal intubation and similar procedures of the remote past." The author sees in uroselectan an invaluable aid and an agent of unlimited possibilities, yet, he urges, it must be remembered that many advances in medical science have been hailed with wild enthusiasm, later discarded, and finally taken up in a sane practical manner, and included in their proper place in our armamentarium.

The claim for the usefulness of intravenous pyelography is that it gives information in three different directions at a single examination: (1) Visualization of the urinary tract and the relationship between its various parts; (2) concerning the kidney function, by roentgenologic means and by chemical findings; (3) regarding the dynamics of the urinary tract through observation of the expulsion of the medium.

The author examines these claims critically in the light of his experience with the 50 cases reviewed in his series. He says:

"Vizualization has been satisfactory for diagnostic purposes in only about two-thirds of the cases. It is never quite so good as in instrumental pyelography, and frequently is very indefinite. When satisfactory, one obtains a composite picture that is otherwise scarcely possible, and the information regarding displacements, ureteral kinks, strictures, etc., is more accurate than could possibly be obtained in any other manner.

"As a radiographic functional test, the method is not a reliable one. While it is excreted in greater concentration by a normal kidney, yet obstruction to emptying of the renal pelvis will also give that greater concentration, such as happens in ureteral obstruction. Then again, while a totally destroyed kidney gives a negative shadow, yet occasionally a perfectly normal kidney gives the same results."

As a chemical functional test its presence in either blood or urine is difficult to determine quantitatively, and it cannot possibly give us more information than the simple dye tests of elimination now in use.

In a study of the dynamics of the urinary tract, when visualization is satisfactory, the results give most satisfactory information, and the author feels that it is in this phase that the method will have its most valuable results. More particularly in the radiographic demonstration of the ureters is this a most valuable method. Slight degrees of dilatation and irregularities are strikingly shown.

The author illustrates clearly all the points above enumerated by reproductions of radiographs.

Disadvantages attached to the method are that all patients complain of pain radiating up the arm, and of thirst. Frequently there is nausea. In two instances, wheals were ob-

served over the chest, and in one case there was a very severe reaction, in fact, a profound collapse and the patient's life was despaired of for an hour.

From a comparative point of view, the instrumental method is preferred by the author, as being easier to administer and experienced by the patient with no more discomfort and less inconvenience. As an adjunct to the instrumental method the intravenous method is valuable in doubtful cases, and is especially indicated in the following instances:

1. Those cases in which, due to anatomical and pathological and technical reasons, it is impossible to do cystoscopy, ureteral catheterization, or instrumental pyelography.
2. In those cases of ureteral obstruction in which the pyelographic solution cannot be injected beyond the obstruction.
3. In those cases in which instrumental pyelography carries a risk for the patient.

The findings of the intravenous method are often very difficult to interpret.

L. J. Carter, M.D.

GENITO-URINARY TRACT (THERAPY)

Pyelography. Proceedings of Société belge de Radiologie, reported by Danzin. Bruxelles-Med., May 24, 1931, XI, 892-894.

Glorieux advocates pyelography by intravenous injection, basing his experience on 87 cases. Care must be taken, however, in patients with low renal permeability. Examination should be made in the Trendelenburg position five minutes after the injection.

The Injection of Uroselectan.—The method is criticized by some. The injection of uroselectan, it is granted, however, frequently makes pyelography by direct injection in the ureter unnecessary, and Glorieux advises one to begin pyelography by intravenous injection and to resort to direct injection through the ureter if the first method has failed.

Bonhomme, who has tried uroselectan in more than 100 cases, has had a few slight reactions—once, a case of tetany. Abrodil, which he has tried in 20 cases, causes milder reaction with as good films.

Jouret is of the opinion that in lithiasis it is better to give preference to intravenous injections, as pyelography by direct injection of the ureter is apt to be followed by infection.

Boine (100 cases) concludes that pyelography by intravenous injection rarely gives an accurate diagnosis and direct injection is almost always needed. He warns against operation on the strength of a pyelography by intravenous injection.

Jules François maintains that the enthusiasm for pyelography by intravenous injection has much declined. The chief objection to pyelography by injecting the ureter is pain. This, he says, is due to faulty technic and insufficient anesthesis of the canal before introducing the cystoscope. He has completely given up gelobarine, which is apt to cause calculi. In intravenous injections, he has used uroselectan or abrodil, and obtains barely 50 per cent of satisfactory results. The interpretation of renal function by elimination of the product is an error; healthy kidneys may give a negative finding. In closing, François says that pyelography by intravenous injection needs more investigating. Its indications are in cases in which the direct injection in the ureter is impossible. In some cases it will sometimes give information more or less reliable, but direct ureteral injection will often be needed for complete information.

Henry Bayon, M.D.

Tumors of the Bladder. John H. Cunningham. Jour. Urol., June, 1931, XXV, 559-587.

We are now in possession of means of destroying most tumors in the benign group through cystoscopic attack, employing fulguration sometimes aided by radium. In a small percentage of this group, however, suprapubic attack is necessary. There is a reasonable mortality from this latter procedure. Recurrences are not uncommon, and may be late, but these in most instances may be handled cystoscopically.

In the malignant group no new method has brought results which stand out in bright contrast to the results of twenty years ago. The urologist in dealing with carcinoma is in the same position as the worker in other branches of surgery dealing with the problem of carcinoma.

In considering the available data on the treatment of malignant tumors, it appears that resection gives the best results. The mortality of both malignant papilloma and infiltrating carcinoma, in which resection was done, is 11.48 per cent. This is one-half of what it was twenty years ago.

The end-results, however, do not go along with this improved mortality. The best chance for local cure lies in resection, with a good margin of healthy tissue. Proper mobilization of the bladder, experience with the radio knife, careful coagulation of the growth with diathermy and a real resection, with or without ureteral transplantation, are the chief factors for success. The author feels that a fair percentage of recurrences are due to failure to really do a clean resection.

For the purpose of treatment the malignant groups may be classified as: *(a)* The tumor which is resectible, and *(b)* the tumor which is not. In the latter group the situation is somewhat improved over that of twenty years ago. To-day we have diathermy, radium, and X-ray at our disposal. The mortality rate twenty years ago was 25 per cent, and recurrences within three years comprised the other 65 per cent.

While diathermy in its present state has but rarely proved a curative measure, it is theoretically better than heat applied by the methods of twenty years ago. Further development may improve its efficiency.

At the present time its value seems to be as an improved means of destroying growths, later to be resected; as a means prior to the employment of radium, and for the destruction of sloughs and bleeding tumors, rather than as a curative measure.

In radium, however, we have a means of treatment in this non-resectional group which has established itself as a real help. Barringer's series, the most authentic, showed a mortality of only 3.18 per cent. In twenty patients with papillary carcinoma, 11, or 55 per cent, were known to be cancer-free over five years; and in 51 patients with infiltrating carcinoma, 12, or 23.5 per cent, had been cancer-free over five years. Beer has shown 30 per cent of apparent cures in this non-resectible group of infiltrating carcinoma treated by Barringer's method. His mortality rate, however, was much higher, 35.4 per cent, probably accounted for by the fact that in Beer's series radium was reserved for the worst type of cases only. The important fact remains, however, that there were some of his patients in this inoperable group that were apparently cured.

The author is convinced concerning the importance of radium, both in emanations and the element, as an adjunct to treatment in resection and in combination with diathermy. Its use cystoscopically, in malignant papillomas and in benign growths resistant to fulguration and as a helpful adjunct in some cases of recurrence, has been definitely proven.

The X-ray, as a possible helpful adjunct prior to operation, as a means of influencing bleeding, and as a post-operative procedure may have some value. As a curative measure, there is no evidence. The fact that in four of Beer's cases treated by X-ray prior to operation, and later subjected to resection, there was no recurrence, is certainly suggestive.

The author feels that the greatest value of X-ray at the present time is that it serves as a "therapeutic crutch" for those unfortunate individuals in whom recurrences have taken place. For such recurrences nothing can be done other than to relieve the mental suffering of the individual by radiation therapy, in addition to suprapubic drainage and the administration of morphia.

He feels that cystectomy is an ideal dream and will long remain a surgical novelty. Also, uretero-enterostomy and nephrostomy to deviate the flow of urine from the bladder without the idea of cystectomy seem to be unnecessary.

Taken all in all, the picture of malignant disease of the bladder is not a pretty one, but should incite one to further improvement in

detail and research for the answer to this condition.

DAVIS H. PARDOLL, M.D.

Uroselectan in a Case of Transplantation of the Ureters. Andrew Fullerton. British Jour. Urol., June, 1931, III, 166-172.

A very interesting case of epispadias and separation of the symphysis is described and accompanied by several pyelograms. Direct pyelography was employed before operation and the progress observed, following transplantation of the ureters into the bowel (Coffey method), by means of uroselectan. This clearly demonstrates the obvious advantage of intravenous urography in this type of case in which instrumental urography would have been impossible.

DAVIS H. PARDOLL, M.D.

The Effect of Pituitary Extract upon the Tonus of the Human Pelvis and Ureter and its Possible Application in the Therapeutics of Pyelitis and Related Conditions. W. B. Draper, Ward Darley, and J. L. Harvey. Jour. Urol., July, 1931, XXVI, 1-11.

The authors made observations on the renal pelvis and ureter, following intramuscular injections of pituitary extract and "pitressin," by means of intravenous urography. They noticed that these injections reduced the size and density of the pelvic and ureteral shadows. The larger the dosage, the more pronounced the pelvic and ureteral visualization became. A marked diminution in the size and density of the shadows occurred from three to seven minutes after the injection of the maximum dose of 15 minims.

Since neither pituitary extract nor "pitressin" when injected intramuscularly produces an antidiuresis in the face of a diuresis previously induced by intravenous uroselectan, it is concluded that the shadow diminishes because of accelerated drainage caused by active ureteral and pelvic peristalsis and not because of antidiuresis.

In the clinical case of pyelitis described, marked relief of pain followed the exhibition of pituitary extract. In this respect, the extract was much more efficient than a sixth of a grain of morphine. The possible mechanism of this action of the extract is discussed. It must be admitted that the therapeutic value of pituitary extract in pyelitis and related urinary conditions is an open question. The results, however, reported in this case of pyelitis, with bilateral hydronephrosis and hydro-ureter, are suggestive, especially in the light of the three preceding conclusions. It is possible that the clinical improvement noted was also due in part to certain changes in the composition of the urine as brought about by pituitary administration. Further investigation into the therapeutic value of pituitary extract, as suggested, is indicated.

DAVIS H. PARDOLL, M.D.

A Discussion of the Diagnosis and Treatment of Upper Urinary Tract Infections. Albert M. Crance. Urol. and Cutan. Rev., July, 1931, XXXV, 418-422.

The author discusses upper urinary tract infections as the result of invasion by the following organisms: *B. coli, streptococcus, staphylococcus,* and the tubercle bacillus. It is strongly emphasized that in all cases with urinary symptoms showing pyuria, the type of infection present should be determined by culture and microscopic examination. A "sterile culture" on a urine containing pus is presumptive evidence of tuberculosis.

The author considers urinary antiseptics of no value in the treatment of *B. coli* infections. The intestinal tract in this case becomes the focus of infection and it is one of the primary points to consider if this type of case is to be successfully treated. The author's method of therapy consists of the following procedures: (1) Weak mercurochrome soapsuds enemas daily for three weeks; (2) alternating fat, protein, and carbohydrate diets; (3) autogenous vaccine therapy, and (4) acidophilus. By persistently using this treatment the average duration of the infection is about ten weeks.

The two chief sources of streptococcic infection of the urinary tract are infected teeth and infected tonsils. The jaws should be carefully studied by means of the X-ray, even if all teeth have been removed. If no dental pathology is demonstrable, the tonsils, regardless of their appearance, must be removed. The prostate and seminal vesicles in the male and the cervix in the female should also be considered as possible foci. In the author's experience, streptococcic infection responded rather well with the use of serenium.

The treatment of staphylococcic infection is similar to the therapy used in streptococcic infection, except as to the drug used. Hexylresorcinol in doses as high as from nine to twelve capsules daily is suggested by the author in infections in which the invading organism is the *Staphylococcus.*

The symptoms observed in tuberculous infection of the urinary tract are very often misleading. Every effort should be made to find the organisms in the urine by the staining method. While in some cases inoculation of a guinea pig with the urine in question may aid in establishing a diagnosis, it should be remembered that not all strains of the tubercle bacillus grow in the guinea pig. It occasionally happens that the diagnosis of tuberculosis is made during the course of a pyelographic study. In these cases a leakage at the calices into the parenchyma is noted. Calcification due to tuberculosis may likewise be seen in a kidney. The author believes that while a pyelogram may be a useful procedure in the diagnosis of tuberculosis, a pyelogram should not be made in this type of case if the diagnosis can be arrived at without this aid.

In the treatment of tuberculosis of the urinary tract, the trend of therapy is gradually turning to the medical rather than to the surgical. While there are exceptions, it should be considered that all cases of tuberculosis of the urinary tract are potentially bilateral in involvement. The treatment, in the author's opinion, should be carried on by rest, proper diet, and ultra-violet therapy.

J. N. Ané, M.D.

GYNECOLOGY AND OBSTETRICS

Intra-uterine Roentgen Cephalometry and Pelvimetry. Henry J. Walton. Am. Jour. Roentgenol. and Rad. Ther., June, 1931, XXV, 758-760.

The author emphasizes the equal importance of fetal skull and maternal pelvic measurements in determining the course of labor, and presents a relatively simple method for obtaining corrected roentgenographic measurements of these parts. The usual antero-posterior projection is made with the mother in the semi-reclining position, according to the method of Thoms, after first determining the distance from the top of the symphysis to the film in order to determine the corrected internal diameters from the film.

Two views, one an antero-posterior and one a lateral, both with the patient in the supine position, are made after first measuring as accurately as possible the distance from the plane of the child's head to the film. A simplified chart for taking film measurements and very quickly converting them into actual fetal and maternal measurements is a valuable feature of the article.

J. E. Habbe, M.D.

A Few Results of Diathermic Treatment in Gynecology. Anciaux. Bruxelles-Med., May 31, 1931, XI, 908-911.

The author claims that diathermy is the best treatment for vaginitis, for gonorrheal metritis, for chronic inflammation of the tubes and ovaries, and for parametritis. His report covers 35 observations of patients treated by diathermy during the past two years.

The vaginal route was uniformly adopted. The amperage was 2½ to 3, the treatments varying from 20 to 30 minutes each, and the number of treatments not usually exceeding ten to twelve. If no results follow the first treatments, to continue will be useless; however, if good results follow the first series of treatments, a second series after an interval of a few weeks may be useful.

Senile vaginitis is the condition most satis-

factorily treated by diathermy. The intolerable itching is relieved after the second or third treatment. The author advises an average of six biquotidian treatments, renewed once or twice a year.

In different forms of metritis, especially chronic cases, diathermy is palliative only, and seldom cures. It, however, is the best form of treatment for gonorrheal metritis, as the gonococcus is not resistant to a temperature of 45 degrees.

Chronic parametritis is well controlled by diathermy, pain and edema yielding to a series of 15 treatments.

In chronic diseases of the tubes and ovaries diathermy finds its most frequent uses; its usefulness, however, is limited to cases of recent origin.

In reference to inflammatory conditions of the uterine cervix, the author cites different opinions on the use of high frequency currents in the form of electrocoagulation, both forms, however, restricted to internal cervical diseases, and not at all applicable in the treatment of endocervicitis.

HENRY BAYON, M.D.

Hemorrhage after the Menopause. H. W. Johnston. Can. Med. Assn. Jour., July, 1931, XXV, 58-60.

Hemorrhage after the menopause should be regarded very seriously, as the cause is most frequently malignant disease of the uterus. We are never justified in treating this condition without making a vaginal examination. When vaginal examination reveals no growth of the cervix, a diagnostic curettage of the uterus should be done to exclude malignant disease of the body. The numbers of inoperable and hopelessly late cases of malignant disease of the uterus are tremendous and appalling, nor do they appear to be lessening. The latest statistics in the British Isles show that one woman in every eight who reaches the age of thirty-five suffers from cancer, carcinoma of the breast and uterus forming more than 90 per cent.

The author discusses the conditions which produce hemorrhage after the menopause under the following headings:

(1) *Carcinoma of the Cervix.*—This is a very common disease both before and after the menopause. The treatment by the Wertheim method of hysterectomy is gradually disappearing, and radium is taking its place. There are several radium technics.

(a) Regaud's technic in Paris. In this technic a maximum highly filtered dose of radium is given at one sitting. Particular stress is laid on preliminary asepsis, obtained by douching with lysol and packing the vagina with sterile gauze soaked in acriflavine. The patient is placed in the lithotomy position and the cervix dilated to a No. 9 Hegar. The radium in a "T"-shaped tube, fully screened with 0.5 mm. of gold or 0.25 mm. of platinum and a thick coating of dental rubber, is inserted in the canal. The maximum dose is given—8,640 milligram-hours. This dose is not repeated.

(b) The Stockholm technic (Forssell's). This is much the same as Regaud's, except that the dose is divided into three sittings, a fortnight apart.

(c) Ward and Farrar's technic (Women's Hospital, New York). Smaller doses of radium are used, from 2,400 to 4,200 milligram-hours, and re-radiation is given for local recurrences.

(2) *Carcinoma of the Body of the Uterus.*—This disease is not nearly so common as carcinoma of the cervix. It occurs more often in nulliparæ, either at the menopause or after. A definite diagnosis can be made only by the curette, when the characteristic brain-like material is obtained. If the diagnosis is doubtful, the curettings should be examined microscopically. Panhysterectomy gives the best results.

(3) *Erosion of the Cervix.*—This consists of a slightly elevated velvety patch extending from the external os over the vaginal portion of the cervix. The diagnosis from carcinoma is made by the fact that scraping of the lesion shows a superficial erosion, leaving a hard resilient surface, whereas carcinoma leaves a friable surface. A microscopic examination will settle any doubt. Curettage and cauterization usually cure it.

(4) *Fibroids.*—After the menopause, bleeding always means some form of degeneration or malignancy; therefore radiation for fibroids should not be used at this period. A simple sub-total hysterectomy will effect a cure.

(5) *Mucous Polypi.*—These spring from the cervix, atrophic as the cervix is at this time of life. The polypi are usually found protruding from the external os. Twisting the polypi off together with curettage cures the condition.

(6) *Senile Endometritis.*—This is a very rare condition and is usually found in multiparæ, the curettings being thin and not cheesy as in carcinoma. The curettage is at the same time the diagnosis and the cure.

L. J. Carter, M.D.

HEART AND VASCULAR SYSTEM (DIAGNOSIS)

New Conceptions Concerning Orthodiagraphy of the Heart. J. Arkussky. Fortschr. a. d. Geb. d. Röntgenstr., July, 1931, XLIV, 39-47.

Orthocardiagraphy, which for quite a few years was practised with considerable enthusiasm, has led most of its former adherents to considerable disillusionment, so that most institutions now prefer teleoroentgenography of the heart, preferably in several varying projections. To cite only a few of the unsolved paradoxical problems and questions, one might remember that, for instance, the volume of the heart increases with inspiration and decreases with expiration; orthodiagraphy, on the other hand, leads to just the opposite conclusions, a discrepancy which, so far, is entirely unsolved. Normal dimensions of the heart are subject to considerable variation, and up to this time no definite relation has been found in constitution, weight, and other measurements of the individual in relation to the size of the heart which could be regarded as normal for orthodiagraphic purposes. Nevertheless, orthodiagraphy should be considered a worthwhile method of examination because it permits of a rather accurate projection of the dimensions of the heart upon the anterior thoracic wall, much more accurate than percussion by even the most experienced examiner. It furthermore gives us an approximate conception of the transverse diameter of the heart in different projections, and finally is a very satisfactory method even for rather inexperienced examiners to obtain quite accurate information concerning any measurements and sizes of heart and aorta.

Several pages of this paper contain a critical review of Bordet's, Vaquez', and Schinz' new method of measuring an orthodiagram. It is shown that this new French method is based upon erroneous conceptions.

The author emphasizes his impression that orthodiagraphy should be practised during deep inspiration. On his observations he also comes to the conclusion that the apex of the heart is usually formed by the left ventricle, while the right ventricle rarely participates in the formation of the apex. It is emphasized also that all orthodiagraphic measurements should be regarded as relative and conditional values and correlated to all other clinical findings concerning the heart.

Hans A. Jarre, M.D.

Concerning the Roentgenologic Diagnosis of Concretion and Accretion of the Heart Erich Zdansky. Fortschr. a. d. Geb. d. Röntgenstr., July, 1931, XLIV, 48-60.

Volhard, in his systemic publication concerning adhesive pericarditis, differentiated between concretion and accretion of the heart. He interpreted the former as adhesive pericarditis involving the visceral and parietal leap of the pericardium and forming a thick, fibrous layer of connective tissue around the heart, interfering considerably with its function and circulation.

With the latter term, he described extensive adhesions between the pericardium and the anterior thoracic wall, also interfering with circulatory function. Both of these pathologic conditions may occur combined. Roentgenologic literature contains an odd number of symptoms concerning adhesive pericarditis. For instance, deformity of the mediastinal shadow, ragged projections of the heart con-

tour, with localized inhibition of excursion of the contractions of the heart, obtusion of the cardiophrenic angles, lack of inspiratory enlargement of the retrosternal space, with cloudy densities in the anterior and posterior mediastinum, retardation of the excursions of the medial portions of the diaphragm, systolic tugging of the left diaphragm, inspiratory tension of one border of the heart shadow, abnormally small pulsatory excursions of the borders of the heart, etc. All these signs are not very reliable as they are often missing, and also may be present without the presence of adhesive pericarditis, caused in such condition as localized mediastinitic changes which do not give the clinical picture of adhesive pericarditis. The author points out that *lack of shifting and rigidity of the heart shadow, with deep respiration in erect and both lateral and horizontal positions,* may be used as direct evidence for the pathogenetic anatomic changes under consideration, that is, fixation and rigid encapsulation of the heart. He points out that respiratory rigidity of the form of the heart in the presence of respiratory mediastinal shifting in both horizontal positions furnishes indications for the diagnosis of concretion of the heart, while respiratory rigidity of the heart combined with respiratory fixation and lack of shifting in both lateral and horizontal positions should be regarded as evidence of accretion of the heart.

In the presence of pneumo- and hydrothorax, typical mediastinal shifting in lateral horizontal positions is often not observed, as the mediastinum is not infrequently found to shift toward the pneumo- or hydrothorax in either lateral or horizontal positions. Such cases, of course, must then be ruled out for consideration of the symptom given. Furthermore, such cases are unreliable if complete hepatization or induration of one lung field has taken place, as in such cases plasticity and mobility of the mediastinum cannot be judged correctly. An unusually large heart, furthermore, does not infrequently show reduced lateral shifting with change of position, which cannot be explained offhand, and, finally, the symptom may not be found in the presence of large pericardial effusion.

HANS A. JARRE, M.D.

A Case of an Atypical Aneurysm of the Aorta. A. Püschel. Röntgenpraxis, Aug. 1, 1931, III, 686-689.

The differential diagnosis between an aneurysm and a pericardial cyst was questionable in this case. Roentgenologic chest examination showed a tumor-like shadow the size of an apple, in the region of the right auricle. There was no pulsation and apparently no connection between the descending aorta and the tumor. Re-examination about a year later showed no increase in size; a malignant growth could, therefore, be excluded. Roentgenologically, the diagnosis of an aneurysm was considered, but the position of the tumor and the irregular edges did not agree with this, being suggestive, rather, of a pericardial cyst (or diverticulum). The dilatation of the aorta should have been considered as a point for the diagnosis of an aneurysm (according to Thoma-Kienböck). An autopsy showed a saccular aneurysm.

H. W. HEFKE, M.D.

THE KIDNEYS

Observations on the Contraction of the Human Kidney Pelvis and Adjacent Portion of the Ureter. Vincent J. Dardinski. Jour. Urol., July, 1931, XXVI, 137-140.

Stimulation of the ureter near the point of attachment to the pelvis seemed to arouse much stronger contractions than those of the pelvis, and response could be obtained from about every ten to fifteen seconds.

In one other kidney, in which the pelvis was much thicker than normal and diffusely involved in a tuberculous process, no response to stimulation could be obtained either in the pelvis or adjacent portion of the ureter.

Because of the limited amount of material, further observations were not made. It is believed, however, that the waves of contraction which have been reported in the ureter have

their origin in the pelvis in the region of the major calices and that these contractions are essential in propelling the urine into the ureter. It is also possible that, from the position in which these contractions originate, they may have some definite effect upon the flow of urine from the tips of the papillæ.

DAVIS H. PARDOLL, M.D.

New Ways in the Treatment of Leukemia: A Preliminary Report. M. Nemenow. Strahlentherapie, June 13, 1931, XLI, 77-85.

New Results in a Study of the Course of Leukemia. Anna Jugenburg and K. Tschotschia. Strahlentherapie, June 13, 1931, XLI, 86-100.

Nemenow emphasizes again his warning, voiced in 1909, not to apply high doses of roentgen rays in leukemia. Recently his extensive studies of the changes in the uric acid of blood and urine have convinced him of the importance of the kidney function in leukemia. Before subjecting the patients to the usual irradiation of the spleen, bone marrow, and lymph glands, he exposes the right and then the left kidney (filtered radiation, 225 and 250 r) in order to reduce the pressure of the myeloid tissue within the kidney on the secretory cells. Two case histories illustrate this contention. Whether the improved function measured by the drop of the uric acid in the blood and an increased excretion in the urine is partly due to an effect of the roentgen rays on the secretory cells remains open to discussion.

In the following article, Nemenow's coworkers report in detail the results of their studies of the purine metabolism in leukemic patients, which gives a definite idea as to the stage of the disease. The increase of uric acid in the blood in leukemia may be due to increased destruction of the leukocytes or to decreased excretion of the insufficient kidneys. If roentgen treatment of leukemia is successful, there is increased excretion of uric acid in the urine and a drop of uric acid in the blood. The severe cases of leukemia always show pathologic changes in the kidneys. They are either of a degenerative nature or consist of myeloid and lymphoid infiltration.

In fatal cases of leukemia the excretion of uric acid in the urine is always decreased and the uric acid content of the blood increased.

Studies of the uric acid in leukemia during X-ray therapy are as important as blood studies, because an increase of uric acid in the blood warns of a beginning intoxication. The diet in leukemia should, therefore, be low in purines, and small doses should be used in roentgen therapy. All patients suffering from leukemia should be considered as having a lowered kidney function.

ERNST A. POHLE, M.D., Ph.D.

LIGHT THERAPY

Metabolism and Sunlight. Otto Kestner, Carl E. Johnson, and W. Laubmann. Strahlentherapie, June 13, 1931, XLI, 174, 175.

The authors found that metabolism is definitely increased following exposure to the sun, even after a heavy meal.

ERNST A. POHLE, M.D., Ph.D.

Automatic Registration of Light with the Mekapion. Siegmund Strauss. Strahlentherapie, May 20, 1931, XL, 696-700.

This is a description of a strip chart arrangement attached to the mekapion dosimeter which permits the registration of the light intensity of various light sources.

ERNST A. POHLE, M.D., Ph.D.

Light Therapy in Medical Practice. A. Lippmann. Strahlentherapie, May 20, 1931, XL, 611-623.

The generally accepted indications for the use of light in diseases are presented in condensed form. As contra-indications the author mentions, for instance, patients with tuberculosis of the lungs, syphilis, an inclination to exudative reactions or an unstable vasomotor system, and nephritis. Caution has to be used

when treating patients with bronchitis, anemia, and exhausted and irritable patients.

ERNST A. POHLE, M.D., Ph.D.

The Quartz Cadmium Lamp. D. Gábor. Strahlentherapie, May 20, 1931, XL, 717-722.

Reiter and Gábor, who have worked a great deal with the mitogenetic radiation (Gurwitsch), found that mitosis of plant cells is increased by wave length 3,400 Å. Considering that this observation might be of value in human therapy, they constructed a quartz cadmium lamp whose maximum output lies around 3,400 Å. Clinical tests during the past two years have shown encouraging results which will be reported by two clinicians.

ERNST A. POHLE, M.D., Ph.D.

To the Seventieth Birthday of Oskar Bernhard. W. Hausmann. Strahlentherapie, June 13, 1931, XLI, 1-10.

This is a brief sketch of the work of Bernhard, the father of heliotherapy of surgical tuberculosis. A complete list of his publications is appended.

ERNST A. POHLE, M.D., Ph.D.

Artificial Sunlight in the Treatment of Laryngeal Tuberculosis. Modified Carbon Arc Light. Joseph W. Miller. Arch. Otolaryngology, March, 1931, XIII, 326-346.

The author discusses various methods which have been used in treating tuberculosis of the larynx. He finds that application of ultraviolet radiation to the larynx has given excellent results. In a series of seventy-four patients with laryngeal tuberculosis, only two did not respond to radiation. Fifty-nine of the seventy-two who responded showed complete healing of the laryngeal lesions. The technic of exposure and a description of a special carbon arc used as a source of radiation are described in detail. A number of case reports with illustrations complete this article.

WILLIS S. PECK, M.D.

THE LIVER

Further Studies in the Application of Intravenous Cholecystography and Liver Function Determination as Employed in Office Practice. Charles A. Waters and Whitmer B. Firor. Am. Jour. Roentgenol. and Rad. Ther., May, 1931, XXV, 590-594.

The authors carefully consider the contraindications and dangers associated with the employment of the intravenous method of cholecystography. They admit the occasional occurrence of sore arms, which they consider, at the present, unavoidable and of no consequence. They carefully separate this group from the more significant endophlebitis obliterans cases. These cases of venous obliteration occur in the readily collapsible veins from approximation of the inflamed internal surfaces to which some of the highly alkaline dye still adheres because of incomplete washing with normal saline. These reactions encountered with the intravenous method are more than counterbalanced by the frequent gastro-intestinal upsets encountered in oral cholecystography, in the authors' opinion.

The advantage of getting a simultaneous liver function test is emphasized. Greatest retentions, amounting to from 70 to 80 per cent of the dye at 30 minutes, were encountered in cases of acute cholangitis and hepatitis, although in one case a retention of 70 per cent was obtained in a patient, 45 years of age, with normal cholecystographic response and no clinical manifestations of hepatobiliary disease.

J. E. HABBE, M.D.

MEASUREMENT OF RADIATION

The International r-unit of X-radiation and D-unit of Radiation, and What They Actually Measure. J. G. Stephens. Jour. Cancer Research Committee, University of Sydney, May 1, 1931, III, 25-27.

This paper briefly emphasizes the fact that an ionization chamber recording radiation dosages in r-units does not directly measure the

total energy represented by the beam or that passing through the ionization chamber. This unit merely measures the amount of energy which one cubic centimeter of air under given conditions will absorb from the radiation. The relation between the number of r-units registered and the total energy conveyed by the beam varies with the wave length. The amount of energy conveyed to the tissues by a γ-ray beam might be ten times that conveyed by an X-ray beam which registers the same number of r-units.

The Importance of Valve Tubes for the Dosis. A. Püschel. Strahlentherapie, June 13, 1931, XLI, 197, 198.

The author observed that changes of valve tubes may cause differences in the output up to 27 per cent. Recalibration is therefore necessary whenever a valve tube is changed.

ERNST A. POHLE, M.D., Ph.D.

The Direct Measurement of the Tube Potential with a Meter in the Treatment Laboratory. Carl Niemann. Strahlentherapie, June 13, 1931, XLI, 199, 200.

The author describes briefly an instrument which permits the accurate measurement of the tube potential in therapy, and the reading off of the peak values on a calibrated meter.

ERNST A. POHLE, M.D., Ph.D.

An Experimental Test of the Ionization Chamber Method of Measuring the Relative Intensities of X-ray Spectrum Lines. Samuel K. Allison and Victor J. Andrew. Phys. Rev., August 1, 1931, XXXVIII, 441-453. (Reprinted by permission.)

A two-compartment ionization chamber has been constructed with the following properties: (1) The fraction of the X-ray energy absorbed in the front compartment could be directly measured; (2) the volume of gas from which the ionic saturation current was drawn was sharply defined; (3) photoelectrons produced in the chamber could not reach the walls before expending their ionizing energy; (4) the direct beam entered and left the chamber through thin windows and encountered no other parts of the chamber.

The relative ionization currents produced in methyl iodide, methyl bromide, argon, sulphur dioxide, and air by the α_1, β_1, γ_1 lines of the tungsten L-series were measured and the ratios obtained after correction for fraction of the direct beam absorbed were found not to vary more than 2.5 per cent in the first four gases. If the air values are corrected for loss through scattering, concordant results are obtained. Similar experiments have been made using the uranium L-series, where large corrections for loss through escape of fluorescent K-radiation must be made, including the case of krypton, where the K limit comes between the uranium $L\beta_1$ and $L\alpha_1$ lines. The results give strong support to the following hypothesis: The saturation current obtained from a given volume of any gas is proportional to the fraction of the X-ray beam transformed into β-rays within it, providing the β-rays come to the end of their ionizing range within the volume.

The Origin of Cosmic Penetrating Radiation. A. K. Das. Naturwissenschaften, 1931, XIX, 305, 306.

On the basis of quantum relations and the assumption that a photon is of the dimensions of its associated wave length, a λ of 0.54×10^{-13} cm. is calculated for the result of the process of annihilation of proton + electron. This is of the order of the cosmic-radiation wave length.

CHEMICAL ABSTRACTS.

The Dependence of the Wave Length of Small Ionization Chambers. II. Pot Ionization Chambers. Heinz Theodor Meyer. Strahlentherapie, June 13, 1931, XLI, 185-196.

The author studied the dependence of the wave length of small pot ionization chambers within a range of H.V.L. in Al, from 0.5 to 5.0 mm. Al. He found that a chamber with

a diameter of 20 mm., a space between electrodes of 8.6 mm., with electrodes made of graphite with 20 per cent A_2O_3 and diaphragms of from 4 to 10 mm. diameter, was independent of the wave length within the range of radiation examined. The maximum dose which could be recorded with this measuring apparatus at lowest sensitivity was approximately 600 r in air. The smallest dose which could be measured over one-tenth of the scale at highest sensitivity corresponded to about 10 r.

ERNST A. POHLE, M.D., Ph.D.

Tests with an Erythema Meter. Albert Dresler. Strahlentherapie, June 13, 1931, XLI, 176-184.

The author tested the erythema dosimeter described by Weyde (*Strahlentherapie*, XXXVIII, 378). It is based on the discoloration of a phototrope solution under the influence of ultra-violet light. The degree of discoloration can be determined. He found that it is suitable for dosimetry of the ultra-violet of a quartz mercury vapor lamp and also for the comparison of the output of various quartz lamps. It cannot be used for the dosage of light sources the spectra of which contain considerable red and infra-red.

ERNST A. POHLE, M.D., Ph.D.

Additional Theory of the Double X-ray Spectrometer. Roy C. Spencer. Phys. Rev., Aug. 15, 1931, XXXVIII, 618-629. (Reprinted by permission.)

It is shown that an X-ray which comes from a point source and is reflected from a fixed and a moving crystal must pass through a focal point fixed in space and also through a second focal point moving with the crystal. These focal points are the best positions for the location of an ionization chamber window or slit. A universal type of crystal mounting is described which permits the study of wave lengths from 0 to 5 Å. without readjustment of the crystals. This style of spectrometer can also be used to measure absolute reflection angles. By using a thin glass window in the X-ray tube and a hydrogen atmosphere around the crystals, wave lengths of 5 Å. may be studied. Graphical methods have been developed which show the effect of the crystal curve and the vertical height of the slits on the shape of the wave length curve. This method can also be used in other types of spectroscopy to study the effect of the spectrometer on the curve.

THE NERVOUS SYSTEM

An Interesting Case of Sciatic Neuritis. William Martin. Western Med. Times, June, 1931, L, 252-254.

In the treatment of nerve inflammation the author believes that care should be used in prognosis as to cure, until the condition is thoroughly studied, and it is determined whether a perineuritis or a true neuritis exists. The pain observed in perineuritis may be of the same character and as severe as in neuritis, but it is of shorter duration and more easily remedied than when the inflammation occurs in the nerve substance. In perineuritis the inflammation involves the nerve sheath and contiguous tissues, and the exudate thrown out in these tissues as well as within the sheath causes pressure symptoms almost as severe as those of a true neuritis.

The author reports the case of a man, 56 years of age, who, about seven months before applying for treatment, had a sudden attack of what he termed lumbago. He was fairly comfortable walking or standing and in the recumbent position, but he found it impossible to sit upon a chair in the usual manner, being forced to assume a semi-reclining position. X-ray examination of his teeth showed infected roots, and he accordingly had all teeth removed. Subsequently, tonsillectomy was performed. Testing by the wave current showed both sciatics to be extremely painful under a very short spark gap current. Urinalysis was negative but for a strong acidity and a trace of albumin.

Treatment of the patient consisted of the

application of the static wave current for twenty minutes over each sciatic notch and then over each articular area. At about the end of two weeks of daily treatment the patient showed the usual evidence of relief of the exudate pressure. This was shown by an increase of the local soreness of the treated areas. The explanation offered is that, as the nerve pressure is relieved and the exudate removed, the nerve is sensitized. The author considers it necessary to speak to the patient about this possibility of being made sore by the treatments. The patient required several weeks of treatment before he was entirely restored to normal, but he has remained well for about ten years.

J. N. Ané, M.D.

Importance of Ophthalmology in Surgery of the Central Nervous System. Miguel Ibañez Puiggari and Manuel Balado. Semana Méd., April 10, 1930, XXXVII, 897-910.

The purpose of this paper is to show how a wrong diagnosis is often made on patients complaining of eye trouble, because the eye complaint, which usually is loss of vision, may be due to an increased intracranial pressure caused by a tumor, hydrocephalus, etc.

Of the 24,490 patients treated during 1929, in the authors' eye clinic, 17 were operated on, and there were found three cases of frontal tumor, two cases of tumor of the right temporal lobe, one case of third ventricle tumor, one case of left occipital lobe abscess, one case of hematoma of the right temporoparietal region, one case of frontal lobe myeloma, two cases of internal hydrocephalus, and two of external hydrocephalus. The authors go into detail concerning the symptoms of each patient and conclude that surgery of the head and ophthalmology are closely allied. They advocate an early diagnosis by the ophthalmologist in order to obtain a good surgical result. Most of the cases they have had have been diagnosed both clinically and radiologically.

N. G. Gonzalez, M.D.

PHYSIOTHERAPY

Physiotherapy: Modus Operandi. Publication Committee. Canadian Med. Assn. Jour., June, 1931, XXIV, 831-833.

This is the fifth of the series of educational papers furnished by the Publication Committee of the Canadian Radiological Society.

Many claims regarding the use of physical agencies in treating disease are founded on definite scientific facts, and clinical observation is not so well recognized as one might logically expect. That certain beneficial effects do obtain that do not permit of adequate explanation is quite as true of the action of physical agencies as in the case of an infinite variety of essential biological processes.

A galvanic current passed through an electrolyte, such as the body fluids, produces at the point of application, the poles, certain polar effects. The positive pole is acid, the negative is alkaline. In the intermediate path heat is produced as a result of the resistance to the passage of ions which carry the electrical charge. This heat produces an increased blood supply, thus eliminating stasis and favoring nutritive processes. In addition, the rapidly traveling hydrogen and hydroxyl ions by collision produce a cellular massage which stimulates cellular functional activity.

Then again at the poles there are definite chemical changes which act on the interepithelial nerve terminals and produce reflex effects which result in widespread trophic changes.

The high frequency electrical current (diathermy) produces heat and electrical massage in the tissues. An interrupted flow of a direct current (galvanism) produces muscular contraction. This is due to a hydrogen-ion concentration in the area of stimulation of the neuromuscular mechanism. Thus muscular massage is accomplished by such currents as interrupted galvanic, sinusoidal, faradic, and static.

Visible light baths and infra-red have the power of penetrating the skin and being absorbed at depth, thus producing heat in the tissues.

Ultra-violet light has the properties of ionization, oxidization, and reduction. Thus it

produces powerful effects in altering local metabolism, and reflexly stimulates beneficial trophic changes.

There is nothing hidden, mysterious, or occult in the treatment of disease by physical therapy, but it requires accurate knowledge of all the factors involved.

L. J. CARTER, M.D.

The Methods and Place of Physiotherapy in Scientific Medicine and General Practice. C. Stewart Wright. Can. Med. Assn. Jour., July, 1931, XXV, 65-68.

This is the sixth article in the series contributed by the Canadian Radiological Society.

The writer treats the subject in a wholly practical manner, basing the discussion on his own experience in orthopedics, including various joint, muscle, and nerve injuries, chronic arthritis, and concurrent conditions that come with them.

Diathermy.—One of the most promising indications for diathermy is in recent injuries, for example, a badly sprained ankle. Diathermy causes an active hyperemia. It is also sedative to the sensory nerves. If it is applied early after the injury—as soon as the action of cold applications has influenced the initial active hemorrhage—a large part of the exudate is removed before it is organized, and there is almost immediate relief of pain. If the treatment is continued daily, there is no residual swelling and fibrosis. A patient so treated is in better condition after a week than he would be in a month without it.

Quartz Light.—This may be used for its general or local effect. As a general measure, it has an undoubted tonic effect on the whole system, and after a few treatments a general feeling of well-being results. Its effect in rickets is well known. It is bactericidal; it increases the calcium and phosphorus content of the blood; it enhances leukocytosis; it produces pigmentation of the skin, which is protective; it is a metabolic stimulant; it is a counter-irritant.

Locally as a counter-irritant it is useful in neuritis and may be used to replace the fly blister. It is used with great advantage in certain skin diseases, and has a wide use in superficial infections, ulcers, etc. The author uses it effectively in combination with diathermy in chronic sinuses, either tuberculous or pyogenic in origin.

The Galvanic Current.—This is used largely in the form of ionization for its effect on chronic joints and scar tissue. We know that the cathode softens and the anode contracts, and we must visualize our pathology and use the current accordingly.

The galvanic current, in its modifications as the sine wave—interrupted direct current—is useful in muscle toning and various forms of muscle paralysis, such as poliomyelitis and other nerve lesions, and in muscle injuries. Along with colon irrigations, we find its abdominal application beneficial in overcoming constipation, accompanying chronic arthritis.

The Faradic Current.—Mainly in the form of the Bristow Coil, the Faradic current is used to stimulate weakened muscles in which the nerve is intact but may be injured or weakened by disuse. For instance, the author has seen cases of disabilities of the shoulder, in which the patient was unable to raise his arm, the disability being cured in from one to five treatments.

Radiant Heat.—This has a very general application, and should precede massage in most cases in which massage is given, such as in injury limited to muscle, or superficial tenderness not requiring diathermy.

Massage.—In the author's work, this is the backbone of all physiotherapy. It supplies the finishing effect to all the treatments, and adds the personal element, as well, which is often absent in all forms of treatment.

The last consideration is how to furnish these aids. The appliances cost money, the treatments take time and must be given by a technician or a nurse, who should also have training in massage. The general practitioner has not the time for such treatments. Groups of physicians should jointly control such treatment centers.

The author makes a strong plea for the regular medical practitioners to become proficient in these various methods of physical therapy and take their exploitation away from

the irregular practitioners. The rationale of the treatment is sound and the effects can be demonstrated much more definitely than can many of the medicinal measures so commonly employed.

L. J. CARTER, M.D.

RADIATION THERAPY

Roentgen Irradiation of Pyogenic and Actinomycotic Conditions. H. G. Zwerg and W. Wissmann. München. med. Wchnschr., Aug. 7, 1931, LXXVIII, 1345, 1346.

Roentgenotherapy in non-specific pyogenic infections offers good results in conjunction with surgery. In actinomycosis it is especially valuable. This disease is most frequent in grain districts and appears in two forms: the tumorous and the fistulous form. It usually involves mouth, pharynx, larynx, or neck. The diagnosis is difficult and depends upon the detection of the Actinomyces fungus in the pus of broken-down areas. The roentgen dose is much higher than in the treatment of other inflammatory conditions, 180 K.V., heavy filter, from 50 to 80 per cent of a S.U.D., which is to be repeated, if indicated. Surgical procedures should be limited to occasional lancing of abscesses and proper drainage. Curetting should be avoided. Internal medication of potassium iodide seems to assist in the treatment.

E. A. MAY, M.D.

Determination of the Field of Irradiation of Suprarenal Glands. Lucien and Bleicher. Compt. rend. Soc. de Biol., Jan. 30, 1931, CVI, 206-208.

The authors report that, in consequence of the growing importance of therapeutic irradiation of the adrenals, a more correct projection of the glands on the posterior abdominal wall than has heretofore been described is much needed. This area of projection, according to these observers, assumes an irregular outline suggesting approximately the usual shape of the organ.

It is difficult from a practical standpoint to define the areas on both sides as they have been obtained. Consequently, the authors suggest a simpler method of including the field of irradiation of the glands on both sides in two quadrilateral areas slightly larger, undoubtedly, than the actual projection areas of the glands but much more convenient to define. That area, regardless of the shape, situation of the gland, or the side, is represented by a rectangle with a vertical long axis limited above by a horizontal line tangent to the apex of the eleventh dorsal vertebra; below by a horizontal line passing through the center of the prominence which corresponds to the apex of the first lumbar spine; medially, by a vertical paramedian juxta-spinous line, tangent to the apices of the spinous processes of the thoracic and lumbar vertebræ; laterally, by a vertical line parallel to the preceding, 6 cm. from the median line.

HENRY BAYON, M.D.

The Radiotherapy of Dry Gangrene by Irradiation of the Suprarenal Region. A. Zimmern, J.-A. Chavany, and R. Brunet. Presse Méd., July 15, 1931, XXXIX, 1061-1066.

The authors refer to the view that certain types of intermittent claudication and consecutive gangrene are due to hyperfunction of the suprarenal bodies, and discuss the results that have been obtained from unilateral suprarenalectomy in these conditions. Although the results of this operation have been sufficiently encouraging, the mortality is very high and there is a danger that it may be followed by signs and symptoms of acute suprarenal insufficiency. These considerations, combined with the fact that the activity of the suprarenals can be depressed by the application of X-rays to them with little danger to the patient, led the authors to try the effects of radiotherapy in intermittent claudication and dry gangrene. Notes of eight cases of these conditions treated by X-rays are given.

It was found that the treatment exercised a markedly beneficial effect upon the pain,

upon the temperature, and upon the gangrenous process in the affected tissues. Moreover, in the cases of intermittent claudication treated it was considered that the incidence of gangrene was reduced. The X-ray dosage was apparently 2,000 (Solomon) R to each suprarenal region in five séances.

An interesting historical account of other forms of radiotherapy in these and associated conditions, reported in the literature by other authorities, is also given.

WALTER M. LEVITT, M.R.C.P., D.M.R.E.

RADIUM

The Advantages of *Polytoma uvella* in the Study of Cellular Radiosensitivity. A. Lacassagne and F. Holweck. Compt. rend. Soc. de biol., May 18, 1931, CVII, 120-122.

The writers had previously found that yeasts offer an excellent object in testing cellular radiosensitivity, yielding important information, but unfortunately lacking in the very essential element of investigation, in that yeasts are susceptible of but a weak radiosensitivity.

It became important, therefore, to find another organism presenting the same advantages as yeasts, but a greater radiosensitivity. A solution of the problem was found in *Polytoma uvella* (a flagellate which develops in regular colonies on gelose) by a method devised by Lwoff.

HENRY BAYON, M.D.

The Presence of Menformon in the Blood of Male Dogs after Radium Irradiation. Paul Engel. Wien. klin. Wchnschr., May 22, 1931, XLIV, 671, 672.

Menformon has been found not only in women as a specific product of the female sexual glands but also in the testis and the urine of healthy men (Laqueur). In the blood of carcinomatous patients of both sexes a high menformon value has been shown to exist. The author exposed a series of healthy male dogs to radium (from 900 to 2,000 milligram-hours) over the testes or the skin. The examination of the blood following the irradiation showed a considerable increase in the menformon, approximating the values reported by other authors in patients with carcinoma, while a test before the radium exposure had been negative. The menformon, in the author's opinion, can be formed by epithelial cells and is not necessarily specific. The questions are open as to whether this hormone, which gives a positive Allan-Doisy test, is the same as menformon, and if it is a necrohormone or a growth hormone.

H. W. HEFKE, M.D.

On the Absence of Elective Fixation of Radium E Associated with Bismuth in Cancerous Cells of Mice Carriers of Spontaneous Epithelioma. A. Lacassagne. Compt. rend. Soc. de biol., June 5, 1931, CVII, 458-461.

It is generally accepted to-day that radioactive substances introduced into an organism affected with cancer are not retained electively by the neoplastic tissue, and it is likewise not admitted that heavy metals, such as lead, are retained in tumor cells. However, certain experiments would tend to attribute this property to bismuth. If this should be so, this metal could well aid the fixation of radium E in the substance of cancer cells.

The author has undertaken to verify the above experiments. He concludes from autoradiograms of the organs of cancerous mice injected with radium E associated with bismuth that there is no elective fixation of the radio-active substance in the cancerous cells.

HENRY BAYON, M.D.

Some Aspects of Radium Therapy. W. Roy Ward. British Jour. Radiol., June, 1931, IV, 291-297.

Radium is often just one method in the treatment of many tumors. In many conditions it has not yet been conclusively proven whether X-rays, radium, or surgery, alone or combined, is the method of choice. Especially in skin, lip, and mouth carcinoma, myeloid

sarcoma, epithelioma of the anus, and carcinoma of the uterine cervix is the place of radium well established, it usually being the preferred method of treatment. Non-malignant conditions in which radium therapy should be given first consideration are: Menopausal hemorrhage, papilloma, and other hypertrophic skin conditions, lupus vulgaris, keloids, cavernous nevi, and tuberculous glands.

J. E. HABBE, M.D.

The Importance of the Time Factor in the Effect of Fractional Radium Treatment on Eudorina Elegans. A. Luntz. Strahlentherapie, June 13, 1931, XLI, 132-134.

A mesothorium preparation equivalent to 10 mg. radium element filtered through 0.2 mm. silver was used in the experiments. It appeared that the lethal dose if applied in one sitting was fairly constant for different colonies. If fractional doses were used, the results depended on the intervals between two exposures. A curve shows the observation in graphic form.

ERNST A. POHLE, M.D., Ph.D.

RESPIRATORY TRACT

Low Mortality Rate in Respiratory Diseases. William W. Pretts. Med. Bull. Veterans' Administration, August, 1931, VII, 752-755.

The author reports that no deaths have resulted primarily from any acute respiratory disease in the United States Veterans' Hospital, Waukesha, Wisconsin, during the last two years. His series includes over 2,500 general admissions during this period, the majority of the patients being from 30 to 50 years of age.

In the author's opinion, the early recognition of respiratory infection and localization of areas of congestion were essential in the successful treatment and the establishment of a low mortality rate. Consequently, an X-ray examination of the chest was made whenever it was possible. As soon as a diagnosis of pulmonary involvement was made, the patient was isolated and active treatment instituted. Dover's powder, aspirin, and phenacetin were employed when indicated. Oxygen was held in reserve for possible use when cyanosis appeared or when there was evidence of extensive involvement of the lungs.

According to the author, diathermy constituted the main line of offense in the treatment of acute respiratory diseases. The patient was completely disrobed and placed between blankets. A hot drink was found beneficial when given before treatments. Two large plates of Crook's metal, warmed, and moistened with glycerine, were placed anterior and posterior to the involved lung. A weak current was turned on and increased very slowly until the patient's tolerance was reached, which in this series was found to be around 1,800 milliamperes. The current was left at maximum strength from 20 to 40 minutes, and at the completion of treatment the current was reduced gradually. Each patient was given two treatments daily until the temperature was normal. The author warns against the possible danger of coagulation as a result of too high milliamperage or prolonged treatment periods.

J. N. ANÉ, M.D.

RICKETS (THERAPY)

Mineral Metabolism in Late Rickets. Genevieve Stearns, Martha Jones Oelke, and Julian D. Boyd. Am. Jour. Dis. Child., July, 1931, XLII, 88-101.

Because of the similarity of the clinical pictures and the blood changes in late rickets and in infantile rickets, it has been assumed that the metabolic disturbances are probably identical. The antirachitic treatment so successful in infantile rickets seems less efficient in some cases of late rickets. Therefore, a study of the mineral metabolism of two girls, 12 and 13 years of age, who presented clinical, roentgenologic, and chemical evidence of active rickets, and of one child of 12 years without rickets, as a control, was made. Definite roentgenologic evidence of calcification of bone was observed.

The two rachitic children retained ample quantities of both calcium and phosphorus during the healing period. The manner of excretion of these elements was similar in both children to that seen in infantile rickets, except that the urinary excretion of calcium remained low during the healing period instead of increasing as in the healing of infantile rickets.

The acid-base relationships of the urine and the retention of total fixed base of these children and the serum calcium were within normal limits.

The serum inorganic phosphorus of each child remained consistently low, between 2 and 3 mg. per hundred cubic centimeters, during the entire period of study, although the rachitic condition was markedly improved in both children.

Roentgenograms demonstrated the improvement clearly.

F. B. MANDEVILLE, M.D.

Chronic Acidosis Secondary to Ureteral Transplantation. Julian D. Boyd. Am. Jour. Dis. Child., August, 1931, XLII, 366-371.

A case of a white boy, 10 years of age, is reported in which, subsequent to transplantation of the ureters into the rectum, chronic acidosis developed, associated with a condition chemically and roentgenologically indistinguishable from active rickets. Both the acidosis and the rickets were corrected by the daily administration of 12 grams of sodium bicarbonate. A smaller dosage controlled the rickets but did not correct the acidosis. The condition is thought by the author to have arisen because of a deficiency of base, induced by the alterations in the nature of acid elimination that the ureteral transplantation necessitated.

Roentgenograms of the left wrist demonstrated evidence of active rickets. Progressive healing was shown at two and four months, and complete healing about one year later.

A giant-cell tumor of the right mandible, proven at operation, developed the following year. The question is raised as to whether or not this was a further manifestation of deranged calcium metabolism.

F. B. MANDEVILLE, M.D.

ROENTGEN INJURIES

Local Secondary and After-effects of Roentgen Rays. Hans Holfelder. Strahlentherapie, June 13, 1931, XLI, 27-38.

General Secondary and After-effects of Roentgen Rays and Professional Injuries. R. Grashey. Strahlentherapie, June 13, 1931, XLI, 39-46.

This is a very interesting discussion of the problem of roentgen injury. Holfelder states that in diagnostic procedure an injury must absolutely be avoided. He speaks of "inflammatory" or "caustic" effects of irradiation but not of "X-ray burns." In superficial therapy of non-malignant lesions, carefully planned dosage should be safe in the hands of the well-trained radiologist. In deep therapy one must differentiate between diseases which require small, medium, or high doses. For the first two groups, injuries are as a rule not to be expected; but in the last group, the produced reaction must be judged on the basis of the underlying pathology. Even the modern fractional dose method has been in use a sufficient time to permit one to stay within safe limits with the total dose. It is possible, of course, that a late injury may develop many years after. Since statistics show that the majority of court cases belongs to the group of untrained or insufficiently trained physicians, the author demands that at least a special preparation of all physicians should be made obligatory before they can qualify to use such a dangerous agent as roentgen rays.

Grashey, who writes on a similar subject, includes also X-ray sickness as well as injuries in the roentgen laboratory. He refers to the monograph by Flaskamp, which appeared in 1930, in which the problem of injuries is discussed in great detail. The susceptibility of the various organs is also briefly related. He believes that in a modernly equipped

laboratory the work should be safe for physician and technical assistants; the grave injuries observed in the pioneers of radiology should become a thing of the past.

ERNST A. POHLE, M.D., Ph.D.

Germ Injuries Caused by Roentgen Rays. Heinrich Martius. Strahlentherapie, June 13, 1931, XLI, 47-66.

This paper does not lend itself well to abstracting because the author discusses critically the most important papers dealing with the effect of ovarian irradiation on the future offspring. While he admits that so far there is no definite proof in man, he feels that there is a great probability of an injurious action and urges greatest caution, even in diagnostic exposure over the female pelvic region.

ERNST A. POHLE, M.D., Ph.D.

Two Cases of Myxedema after Roentgenotherapy for Graves'-Basedow's Disease. Delherm and Morel-Kahn. Bull. et Mém. de la Soc. de Radiol. Méd. de France, May, 1931, XIX, 210-216.

Short summaries are given of two of a total of five cases of myxedema in a series of four hundred cases of Graves' disease treated by roentgenotherapy.

In the first case, a woman of 52, because of typical symptoms and signs of Graves' disease of two and one-half years' duration, received three series of treatments of 1,200 roentgen units each, filtered by 5 mm. of aluminum, to the right and left lateral thyroid area. The treatments were given over a period of four months. Six months after the final treatment she had become very obese, apathetic, fatigued easily, and myxedema in all of its signs and symptoms was present. Six years later she was practically well—there were no cardiac irregularities nor cardiac enlargement, and the basal metabolic test was normal.

In the second case, a female of 38 years had suffered for thirteen months with hyperthyroidism. Over a period of five months she received two series of X-ray treatments. At each series a total of 3,000 roentgen units in a divided dosage of 500 roentgen units each were given, filtered through 0.5 mm. zinc and 2 mm. aluminum, a single anterior thyroid field being used. Following this treatment her physical condition improved greatly. Approximately six months later a myxedematous crisis occurred. She gained weight rapidly, became absolutely apathetic and manifested suicidal tendencies; her sensations of heat and cold became affected. It was necessary to administer thyroid extract. Seven years later the exophthalmic symptoms and signs as of her first condition before roentgenotherapy had returned.

CHARLES S. CAPP, M.D.

THE SINUSES (DIAGNOSIS)

Leakage of Cerebrospinal Fluid through the Cribriform Plate of the Ethmoid Bone. A. B. Singleton. Canadian Med. Assn. Jour., June, 1931, XXIV, 838, 839.

This is a case report of a patient who, in 1921, complained of a drip from the right nostril of about four large drops per minute. Examination showed that the drip came from high up toward the cribriform plate of the ethmoid bone. X-ray examination of the sinuses and the Wassermann test were negative; the blood pressure was 120/80.

She went on until 1928, the drip continuing and there being several dizzy spells and an occasional occipital headache. In 1928, she had one convulsion and another one in 1930. The drip continued and the last convulsion was followed by a period of semi-consciousness. The cerebrospinal fluid obtained by lumbar puncture was under 20 mm. Hg. pressure, and was water-clear.

Following this attack there was no drip or other disturbances for a period of a year. Then she had a seizure which was much the worst yet. She had occipital headache, rigidity of the neck, and was in a semi-comatose condition. Her temperature was 102°. The cerebrospinal fluid was under much pressure, and was turbid. The cell count was 4,590 cells per cubic centimeter. The fluid contained a few

bacilli. Following the second lumbar puncture the temperature returned to normal and the patient made a good recovery. The drip returned while the patient was in the hospital.

The author remarks that he cannot find any literature pertaining to such cases. He regards it as an established fact that the drip is cerebrospinal fluid escaping through the cribriform plate of the ethmoid. The cause of this leakage is undetermined.

L. J. CARTER, M.D.

THE SKIN (GENERAL)

The Etiology of the Light Erythema from the Standpoint of the Latent Time. F. Ellinger. Strahlentherapie, May 20, 1931, XL, 760-764.

The author believes that the reddening of the skin following exposure to light represents a complex process. Some of the factors responsible for it may be the formation of a compound with histamin-like effect of the liberation of a histamin substance already present in skin cells. This explanation is in accordance with the hypothesis of Krogh.

ERNST A. POHLE, M.D., Ph.D.

Variation in Radiosensitivity of the Skin of Man and of the Lower Animals, and of the Rabbit Testicle, According to Spacing of Radiation. A. Gunsett and J. Meyer. Compt. rend. Soc. de biol., May 8, 1931, CVII, 58-60.

The attempt is made to demonstrate the difference in tolerance to irradiation between the rabbit skin treated by the single massive dose method and the tolerance of the same animal under identical conditions and irradiated with the same dose, but divided and spaced in 48-hour intervals between two sittings, applied under conditions usually observed in the roentgenotherapy of human cancer; that is, in filtering the rays through 2 mm. of copper and 1 mm. of aluminum. In the authors' experience, division of the irradiation dose in twelve portions, with two-day intervals, increases the cutaneous radioresistance in the ratio of about three to one.

Concerning the mode of irradiation of the rabbit testicle, it was found that the lower threshold of definite sterilization is fixed between 2,250 r and 3,000 r, divided in twelve equal portions for a period of 24 days with two-day intervals between sittings.

HENRY BAYON, M.D.

RATES ON VARIOUS TYPES OF ROOMS AT THE NEW HOTEL JEFFERSON, ST. LOUIS

Room with bath for one person	$3.50,	$4.00,	$4.50,	$5.00,	$6.00
Room with bath for two persons	5.00,	6.00,	7.00,	8.00	
Room with tub and shower for one person	4.00,	4.50,	5.00,	6.00	
Room with tub and shower for two persons	6.00,	7.00,	8.00		
Room with bath and shower, twin beds	7.00,	8.00			
Parlor suites for one person	$7.50 to $12.00				
Parlor suites for two persons	9.00 to 15.00				

EDWIN C. ERNST, M.D.
Chairman, Local Executive Committee

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PRELIMINARY PROGRAM, SEVENTEENTH ANNUAL MEETING ST. LOUIS, NOV. 30-DEC. 4, 1931

Scientific Assembly Program

Monday, November 30

8:00 A. M.—Registration

Visit Scientific Exhibits

10:00 A. M.—Scientific Sessions

Section A.

1. Charles C. Lund, M.D., Boston, Mass.
   "Malignant and Pre-malignant Conditions of the Mouth and Lips."
2. Miss Grace Ballard, Milwaukee, Wis.
   "Study of the Combustion Products of Films."
3. Samuel Brown, M.D., Cincinnati, Ohio.
   "Thoracic Aorta."
4. P. E. Thal, M.D., Chicago, Ill.
   "Intragastric Photographs Confirming Indirect Roentgen Findings in Early Gastric Pathology."
5. A. Mutscheller, Ph.D., New York, N. Y.
   "Quanta Energy *versus* Biological Effects."

Section B

6. Eugene Freedman, M.D., Cleveland, Ohio.
   "Leontiasis Ossea."
7. C. H. Heacock, M.D., Memphis, Tenn.
   "Roentgen Findings in Allergic Individuals."
8. Joseph C. Bell, M.D., Louisville, Ky.
   "The Significance of Movements of the Cecum in Diagnosis of Diseases of the Appendix."
9. Frederick H. Rodenbaugh, M.D., San Francisco, Cal.
   "Medico-legal and Medical Economics Symposium."
10. Sam W. Donaldson, M.D., Ann Arbor, Mich.
    "Medico-legal Considerations of X-ray."

12:30 P. M.—Luncheon

Monday, November 30

2:00 P. M.

General Assembly

Edwin C. Ernst, M.D., Chairman
Local Executive Committee

Invocation

Address of Welcome—
C. E. Hyndman, M.D., President, St. Louis Medical Society.

Response for the Society—
Lloyd Bryan, M.D., Chairman, Executive Committee.

Introduction of President and Presentation of Pfahler Gavel—

Bundy Allen, M.D.
"The Scope of the Activity of the Roentgenological Physician."

11. Lewis Gregory Cole, M.D., New York, N. Y.
12. James Ewing, M.D., New York, N. Y.
13. George H. Semken, M.D., New York, N. Y.

Discussion Opened by—

5:00 P. M. to 6:00 P. M.—Clinics

5 P. M

Meeting of Publication Committee, Editorial Staff, and Abstractors

Monday, November 30

Evening Session

6:30 P. M.

Counselors' Dinner
and
Important Business Session

All Members are Urged to be Present

Call to Order—

BUNDY ALLEN, M.D., President, Radiological Society of North America.

Announcements—

EDWIN C. ERNST, M.D., Chairman, Local Executive Committee.

Presentation of Pfahler Gavel to FRANCIS CARTER WOOD, M.D., President-elect.

Counselors' Session

Address—BUNDY ALLEN, M.D.

Executive and General Business Session

Adjournment

Tuesday, December 1

9:00 A. M.—Morning Session

Section A

Symposium on the Diagnosis and Treatment of Lesions of the Central Nervous System

Leader: HENRY K. PANCOAST, M.D.
Philadelphia, Pa.

14. A. W. ADSON, M.D., Rochester, Minn.
"Roentgenologic Aspect of Spinal Cord Lesions."

15. JOHN D. CAMP, M.D., Rochester, Minn.
"Meningiomas of the Olfactory Groove and Tuberculum Sellæ, and the Roentgenological Characteristics."

16. PAUL C. HODGES, M.D., Chicago, Ill.
C. S. CAPP, M.D., Chicago, Ill.
"Irradiation of Brain Tumors."

17. BERNARD J. ALPERS, M.D., Philadelphia, Pa.
HENRY K. PANCOAST, M.D., Philadelphia, Pa.
"The Effect of Irradiation upon Normal and Neoplastic Brain Tissues."

18. VINCENT C. JOHNSON, M.D., Ann Arbor, Mich.
"Ventriculography."

19. EUGENE PENDERGRASS, M.D., Philadelphia, Pa.
Title to be announced.

20. KARL KORNBLUM, M.D.
Title to be announced.

Section B

Symposium on X-ray and Radium Protection

Leader: G. FAILLA, D.Sc.,
New York, N. Y.

21. LAURISTON S. TAYLOR, M.A., Washington, D. C.
"Résumé of Recommendations of the International Congress of Radiology."

22. W. S. WERNER, E.E., Covington, Ky.
"Protection from the Standpoint of the Manufacturer of X-ray Apparatus."

23. Essayist to be announced.
"Fire Hazard in the X-ray Department."

24. Essayist to be announced.
"Protection in X-ray Diagnosis."

25. K. W. STENSTROM, PH.D., Minneapolis, Minn.
"Protection in X-ray Therapy."

26. G. FAILLA, D.Sc., New York, N. Y.
"Protection from Gamma Rays and 900 K.V. X-rays."

Tuesday, December 1

2:00 P. M.—Afternoon Session

Section A

Symposium on Pediatrics

Leader: DOUGLAS D. MARTIN, M.D., Tampa, Fla.

27. THEODORE S. ZAHORSKY, M.D., St. Louis, Mo.
"The Significance of Thymus and Upper Respiratory Diseases."

28. C. C. COLEMAN, M.D., Richmond, Va.
"Brain Abscess as a Complication in Sinus Disease."

29. FREDERICK K. HERPEL, M.D., West Palm Beach, Fla.
"Roentgenological Examination of the Nasal Accessory Sinuses in Infants and Children."

30. LEON T. LEWALD, M.D., New York, N. Y.
"Roentgenological Examination of the Digestive Tract of Infants and Children."

31. E. K. SHELTON, JR., M.D., Santa Barbara, Cal.
"Osseous Development as an Index of Metabolism."

32. JOSEPH COLT BLOODGOOD, M.D., Baltimore, Md.
"Two Cases of Bone Tumor in Children."

Section B

Symposium: Subject to be announced.

Leader: BENJAMIN H. ORNDOFF, M.D. Chicago, Ill.

33. Essayist to be announced.
"The Appendix, Cecum, and Ascending Colon, from the Standpoint of the Internist."

34. Essayist to be announced.
"Diagnosis of a Pathologic Appendix."

35. Essayist to be announced.
"The Radiological Examination of Conditions of the Cecum and Ascending Colon, Not Associated with Appendicitis."

36. Essayist to be announced.
"The Appendix, Cecum, and Ascending Colon, from the Standpoint of a Surgeon."

37. SIDNEY A. PORTIS, M.D., Chicago, Ill.
"Clinical Significance of Duodenal Stasis."

Tuesday, December 1

8:00 P. M.—Evening Session

Joint Meeting with the St. Louis Medical Society

Meeting Called to Order by President ALLEN
Chairman: C. E. HYNDMAN, M.D., President, St. Louis Medical Society

Symposium on the Diagnosis of Diseases and Abnormalities of the Gastrointestinal Tract

Leader: THOMAS A. GROOVER, M.D., Washington, D. C.

38. HENRY K. PANCOAST, M.D., Philadelphia, Pa.
"The Pharynx and Esophagus."

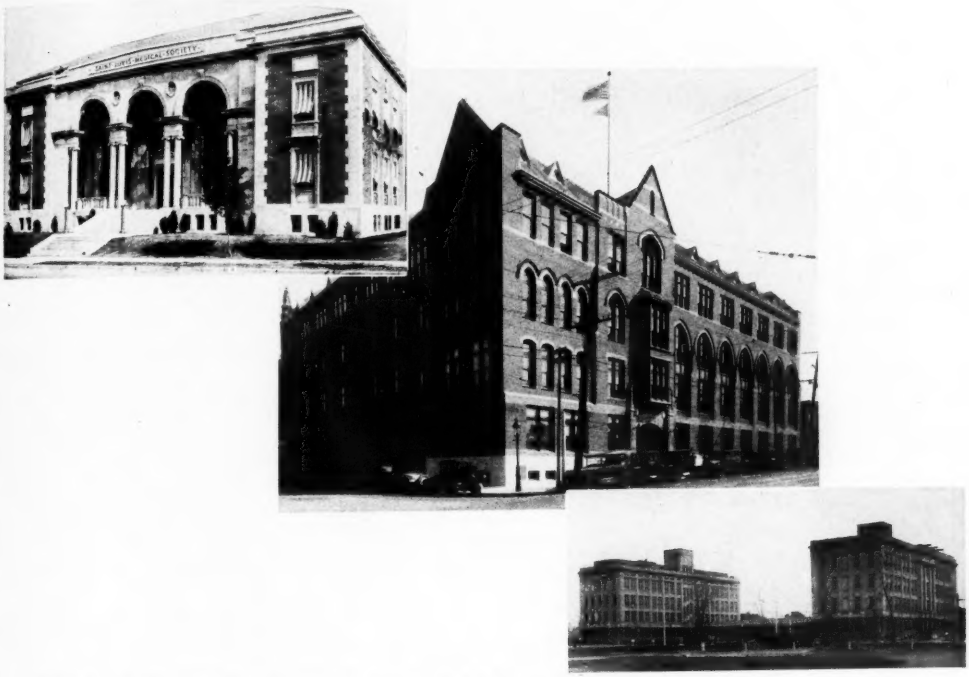
39. A. B. MOORE, M.D., Washington, D. C.
"Gastric and Duodenal Ulcer."

40. B. R. KIRKLIN, M.D., Rochester, Minn.
"Neoplastic Diseases of the Stomach."

41. HORACE W. SOPER, M.D., St. Louis, Mo.
"The Small Intestine."

42. JOHN L. KANTOR, M.D., New York, N. Y.
"The Colon."

43. EVARTS A. GRAHAM, M.D., St. Louis, Mo.
"The Liver and Gall Bladder



Saint Louis Medical Society (upper left); Saint Louis University Medical School (center); North and South buildings, School of Medicine, Washington University (lower right).

Wednesday, December 2

9:00 A. M.—Morning Session

Section A

44. LOUIS G. ALLEN, M.D., Kansas City, Kans.
"Bronchography, a Valuable Aid to the Radiologist."

Symposium on Urology

Leader: N. G. ALCOCK, M.D., Iowa City, Ia.

45-52. Essayists and titles to be announced.

Section B

Symposium on Apparatus

Leader: ARTHUR W. ERSKINE, M.D., Cedar Rapids, Iowa

53. Essayist to be announced.
"Selection of Pieces of Apparatus in the Order of Their Importance."

54. Essayist to be announced.
"Protection."

55. Essayist to be announced.
"The Selection and Care of Tubes."

56. Essayist to be announced.
"The Advantages and Disadvantages of Small Chamber Measuring Apparatus."

57. Essayist to be announced.
"The Advantages and Disadvantages of Large Chamber Measuring Apparatus."

58. Essayist to be announced.
"Records."

59. EDWARD H. SKINNER, M.D., Kansas City, Mo.
"An Oration upon Radiology as a Means of Stimulating Younger Men, Establishing Ethics and Methods."

60. N. P. COLWELL, M.D., Chicago, Ill.
Title to be announced.

61. D. S. BEILIN, M.D., Chicago, Ill.
"The Management of Roentgenological Practice in Hospitals."

Section C

62. OTIS M. WALTER, M.D., Chicago, Ill.
ANDREW C. IVY, M.D., Chicago, Ill.
"The Effects of X-ray on the Experimental Hyperplastic Thyroid."

63. ROBERT E. FRICKE, M.D., Rochester, Minn.
"Results of Surgery and Radium in Cancer of the Thyroid."

64. J. CASH KING, M.D., Memphis, Tenn.
"Hyperpyrexia Produced by Diathermy and Its Field of Usefulness."

65. BENJAMIN H. SHERMAN, M.D., Hollywood, Cal.
"Acne."

Section D

66. BYRON H. JACKSON, M.D., Scranton, Pa.
"Undescended Scapula, with an Omovertebral Bone and without Spinal Defects."

67. LOWELL S. GOIN, M.D., Los Angeles, Cal.
"Idiopathic Osteopsathyrosis."

68. WALLACE DUNCAN, M.D., Cleveland, Ohio
"The Results of Treatment of Low Back Pain."

69. HENRY W. MEYERDING, M.D., Rochester, Minn.
"Diagnosis and Roentgenologic Evidence in Spondylolisthesis."

70. ARTHUR B. GILL, M.D., Philadelphia, Pa.
"Orthopedics."

Wednesday, December 2

2:00 P. M.—Afternoon Session

Section A

Smithsonian Institution, Washington, D. C.
Division of Radiation and Organisms, Fixed Nitrogen Research Laboratory.

Symposium: Dr. Francis Carter Wood
Leaders: DR. COTTRELL
DR. F. S. BRACKETT

71-77. Essayists and titles to be announced

78. S. B. HENDRICKS, Washington, D. C.
"The X-ray Structure of Bone."

Section B

Symposium on the Heart

Leader: FRED J. HODGES, M.D., Ann Arbor, Mich.

79. PROF. W. J. MEEK, University of Wisconsin, Madison, Wis.
Title to be announced.

80-84. Essayists and titles to be announced.

Section C

85. ERNST A. POHLE, M.D., PH.D., Madison, Wis.
"The Effects of Roentgen Rays on the Healing of Wounds."

86. GEORGE H. SEMKEN, M.D., New York, N. Y.
"Radical Surgery in the Treatment of Cancer."

87. VILRAY P. BLAIR, M.D., St. Louis, Mo.
"The Surgical Repair of Radium and X-ray Keratoses."

88. ROLLIN H. STEVENS, M.D., Detroit, Mich.
"Phototherapy on Late Effect."

89. CARL J. JOHANNESSON, A.M., M.D., Walla Walla, Wash.
"Intravenous Injection of Uroselectan *versus* Retrograde Pyelography."

90. OSCAR V. BATSON, M.D., Philadelphia, Pa.
"Roentgenology and Anatomy."

Section D

Symposium on the Thyroid

Leader: E. L. JENKINSON, M.D., Chicago, Ill.

91-93. Essayists and titles to be announced.

94. MANUEL F. MADRAZO, M.D., Mexico City, Mexico.
"A Contribution to the Treatment of Thyrotoxicosis by Means of Roentgenotherapy."

95. L. W. DEAN, M.D., St. Louis, Mo.
"Nasal Accessory Sinus Diseases Clinically and Roentgenographically Correlated."

96. W. L. Ross, M.D., Omaha, Neb.
"X-ray Treatment of Mastoiditis and Report of Results in Forty-four Cases."

97. J. C. DICKINSON, M.D., Tampa, Fla.
"The Importance of the X-ray Examination of the Nasal Accessory Sinuses in Chronic Non-tuberculosis Lung Conditions."

Wednesday, December 2

8:00 P. M.—Evening Session

Symposium to be Conducted by the United States Bureau of Standards

98-102. Essayists and titles to be announced.

Thursday, December 3

9:00 A. M.—Morning Session

Section A

Bone Symposium

Leader: DALLAS B. PHEMISTER, M.D., Chicago, Ill.

103. DALLAS B. PHEMISTER, M.D., Chicago, Ill.
"The Pathology of Certain Types of Bone Tumors."

104. PAUL C. HODGES, M.D., Chicago, Ill.
"The Roentgen Diagnosis of Bone Tumors."

105. GEORGE E. PFAHLER, M.D., Philadelphia, Pa.
"The Results of X-ray Treatments on Bone Malignancy."

106. CARLETON B. PEIRCE, M.D., Ann Arbor, Mich.
"Surgical and Irradiation Therapy of Benign Giant-cell Tumors."

Section B

Symposium on Grenz-ray Therapy

Leader: ERNST A. POHLE, M.D., PH.D., Madison, Wis.

107-110. Essayists and titles to be announced.

Section C

111. HARRY B. PODLASKY, M.D., Milwaukee, Wis.
NORBERT ENZER, M.D., Milwaukee, Wis.
"The Detection of Syphilis in the New-born by Radiological and Serological Methods."

112. Essayist and title to be announced.

Section D

113. LEON T. LEWALD, M.D., New York, N. Y.
"Transposition of the Viscera, Report of Thirty-nine Cases."

114. AARON ARKIN, M.D., Chicago, Ill.
"Right-sided Retro-esophageal Aorta: a New X-ray Picture: Report of Four Cases."

115. ERNST A. MAY, M.D., Newark, N. J.
"Bilateral Diaphragmatic Hernia."

Thursday, December 3

2:00 P. M.—Afternoon Session

Section A

116. DOUGLAS QUICK, M.B. (Tor.), New York, N. Y.
"Conservative Surgical Measurements Facilitating Radium Implantation."

Symposium on Myeloma or Ewing Tumor

Leader: A. U. DESJARDINS, M.D., Rochester, Minn.

117. Essayist to be announced.
"General and Clinical Consideration."

118. JAMES EWING, M.D., New York, N. Y.
"Pathological Study."

119. Essayist to be announced.
"Radiological Aspect."

120. A. U. DESJARDINS, M.D., Rochester, Minn.
WALTER M. BOOTHBY, M.D., Rochester, Minn.
"Radiotherapy."

121. W. B. COLEY, M.D., New York, N. Y.
Title to be announced.

122. E. L. JENKINSON, M.D., Chicago, Ill.
"Hodgkin's Disease."

123. A. DAVID WILLMOTH, A.M., M.D., Louisville, Ky.
"The Use of the X-ray Treatment of Tuberculous Lymphatic Glands of the Neck."

Section B

Symposium on the Use of Radium

Leader: SANFORD M. WITHERS, M.D., Denver, Colo.

124. Essayist to be announced.
"Biological Effects of Radiation."

125. Essayist to be announced.
"Practical Application of Radium."

126. H. S. MARTLAND, M.D., Newark, N. J.
"Bone Sarcoma by the Injection of Radio-active Substances."

Section C

127. LEO G. RIGLER, M.D., Minneapolis, Minn.
"Roentgenologic Visualization of Abdominal Masses."

128. ARTHUR R. BLOOM, M.D., Detroit, Mich.
S. K. BEIGLER, M.D., Detroit, Mich.
"Lesions of the Small Bowel."

129. LEON J. MENVILLE, M.D., New Orleans, La.
J. N. ANÉ, M.D., New Orleans, La.
S. N. BLACKBERG, M.D., New Orleans, La.
"A Comparative Study of the Motility of the Gastro-intestinal Tract of Rachitic Rats with Healed Bone Lesions."

130. ALLAN J. HRUBY, M.D., Chicago, Ill.
MINAS JOANNIDES, M.D., Chicago, Ill.
"Gastric Motility as Influenced by the Paralysis of the Diaphragm."

131. MAX KAHN, M.D., Baltimore, Md.
Title to be announced.

132. ROBERT L. STONE, M.D., San Francisco, Cal.
"Wedge-shaped Vertebræ and Kummell's Disease."

Section D

133. C. S. BUCHER, M.D., Champaign, Ill.
"Further X-ray Diffraction Studies of the Fine Structures of Normal and Pathological Tissues."

134. DAVID P. BARR, M.D., St. Louis, Mo.
"The Relation of Abnormal Calcium Metabolism to Diseases of Bone."

135. OTTO GLASSER, PH.D., Cleveland, O.
"Evolution of the Roentgen Rays."

136. ARTHUR W. FUCHS, Eastman Kodak Co., Rochester, N. Y.
"Radiography and Clinical Photography."

Thursday, December 3

Annual Banquet

8:00 P. M.

Reception

Convocation

Entertainment

Introductions
Honored Guests

Awarding of the Society's Certificates and Gold Medals

Dancing

Friday, December 4

9:00 A. M.—Morning Session

Section A

Symposium on High Voltage X-ray

Leader: FRANCIS CARTER WOOD, M.D., New York, N. Y.

137-139. Essayists and titles to be announced.

140. F. L. RECTOR, M.D., Evanston, Ill.
"Organization for Cancer Service."

Section B

Symposium on the Diagnosis and Treatment of Pulmonary Abscess, Bronchiectasis, and Bronchial Neoplasm

Leader: JOHN T. FARRELL, JR., M.D., Philadelphia, Pa.

141. ELMER H. FUNK, M.D., Philadelphia, Pa.
"Clinical Aspect."

142. LOUIS H. CLERF, M.D., Philadelphia, Pa.
"Bronchoscopic Aspect."

143. JOHN B. FLICK, M.D., Philadelphia, Pa.
"Surgical Aspect."

144. JOHN T. FARRELL, JR., M.D., Philadelphia, Pa.
"Radiological Aspect."

Section C

145. JULIUS FRIEDENWALD, M.D., Baltimore, Md.
MAURICE FELDMAN, M.D., Baltimore, Md.
"The Roentgenological Significance of the Filling of the Ampulla of Vater."

146. J. F. HERRICK, M.D., Ottumwa, Iowa.
"The Gall Bladder."

147. J. E. HABBE, M.D., Milwaukee, Wis.
"Clinical-roentgenological Correlation of Liver Size."

Section D

148. FAUNTLEROY FLINN, M.D., Decatur, Ill.
"Pneumonoconiosis."

149. HOWARD P. DOUB, M.D., Detroit, Mich.
"Pneumonia from Inhalation of Poisonous Gases."

150. M. L. PINDELL, M.D., Los Angeles, Cal.
"Pathological Activity as It Relates to Pulmonary Tuberculosis."

151. WILLIAM J. HUDSON, M.D., Detroit,
"Roentgenology as an Aid to the Thoracic Surgeon (Personal Experiences)."

Friday, December 4

2:00 P. M.—Afternoon Session

Section A

Symposium on Gynecology and Obstetrics

Leader: MAXIMILIAN J. HUBENY, M.D., Chicago, Ill.

152. J. H. DANIEL, M.D., Sterling, Colo.
"Roentgen Therapy and the Menopause."

153. JOHN H. VAUGHAN, M.D., Amarillo, Tex.
"Indications for Irradiation in Intrauterine Bleeding."

154. JOSEPH J. EISENBERG, M.D., Milwaukee, Wis.
"Roentgen-ray Exploration (Diagnosis) of Pelvic Viscera with Aid of Lipiodol."

155. A. JEROME THOMAS, M.D., Shreveport, La.
"Radiographic Diagnosis of Early Pregnancy."

156. JESSE O. PARKER, M.D., Owosso, Mich.
"The Release by Roentgen Therapy of Intra-peritoneal Adhesions in the Abdominal and Pelvic Cavities, as Personally Observed during the Past Eleven Years."

Section B

157. JOSEPH C. BLOODGOOD, M.D., Baltimore, Md.
"The Working Rule in the Diagnosis and Treatment of a Lesion of Bone, with Cases Illustrating Mistakes and Successes."

158. Charles F. Geschickter, M.D., Baltimore, Md.
"Bone Tumors."

159. Charles G. Sutherland, M.B. (Tor.), Rochester, Minn.
"Metastatic Malignant Lesions in Bone."

Section C

160. Hayes E. Martin, M.D., New York, N. Y.
Edith H. Quimby, M.A., New York, N. Y.
"Some Technical Considerations in the Choice of Radiation Methods for Superficial Growths."

161. Henry Schmitz, M.D., Chicago, Ill.
"Five-year End-results in Carcinomas Cervico-utero."

162. Franklin I. Shroyer, M.D., Dayton, Ohio.
"Prevention and Treatment of Uterine and Cervical Cancer."

163. Perry B. Goodwin, M.D., Peoria, Ill.
"Metastatic Breast Carcinoma, with Report of Especially Interesting Case."

164. Benjamin H. Orndoff, M.D., Chicago, Ill.
"Carcinoma of the Breast and Its Management."

165. Clyde K. Hasley, M.D., Detroit, Mich.
Title to be announced later.

Section D

166. Clarence O. Simpson, M.D., St. Louis, Mo.
"Responsibilities in Dental Radiography."

167. Hans A. Jarre, M.D., Detroit, Mich.
"The Roentgen Symptomatology of the Infected Urinary Passages, with Especial Consideration of Their Malfunction."

168. Ira H. Lockwood, M.D., Kansas City, Mo.
"The Roentgen Diagnosis of Tumors of the Kidneys."

169. James Gardner, M.D., Cleveland, Ohio.
"Cerebral Pneumograms."

170. Ernest Kraft, M.D., Chicago, Ill.
Title to be announced.

ADDITIONAL TITLES RECEIVED FOR THE ST. LOUIS PROGRAM:

171. Bernard Pierre Widmann, M.D., Philadelphia, Pa.
Title to be announced.

172. Arthur C. Heublein, M.D., Hartford, Conn.
"A Preliminary Report on Long Distance Irradiation."

173. Ernst A. Pohle, M.D., Ph.D., Madison, Wis.
"The Behavior of Air-cooled X-ray Tubes on Transformers with Valve Tube Rectification."

174. L. S. Otell, M.D., Washington, D. C.
"Roentgenological Demonstration of the Liver and Spleen, after the Intravenous Administration of Thorium Dioxid Solution."

175. H. C. Rentschler, Westinghouse Co., Bloomfield, N. J.
Title to be announced.

176. Paul F. Cole, M.D., Springfield, Mo.
"New Application of Flat Bucky Grid to Any Angle, with Especial Reference to Head Work."

177. William Alfred Jones, M.D., Kingston, Ontario, Canada.
"Tumors of the Jaw."

178. E. A. Gatterdam, M.D., Phoenix, Ariz.
Title to be announced.

179. G. Peter, M.D., Mexico City, Mexico.
"Recent Advances in the Diagnosis of Duodenal Ulcer."

180. Clarence M. Henry, M.D., Regina, Sask., Canada.
"The Cancer Problem as It Affects Western Canada."